REFURBISHMENT SCENARIOS FOR POST-WAR INDUSTRIALIZED HOUSING IN BEOGRAD

PhD Thesis 2015

UPC

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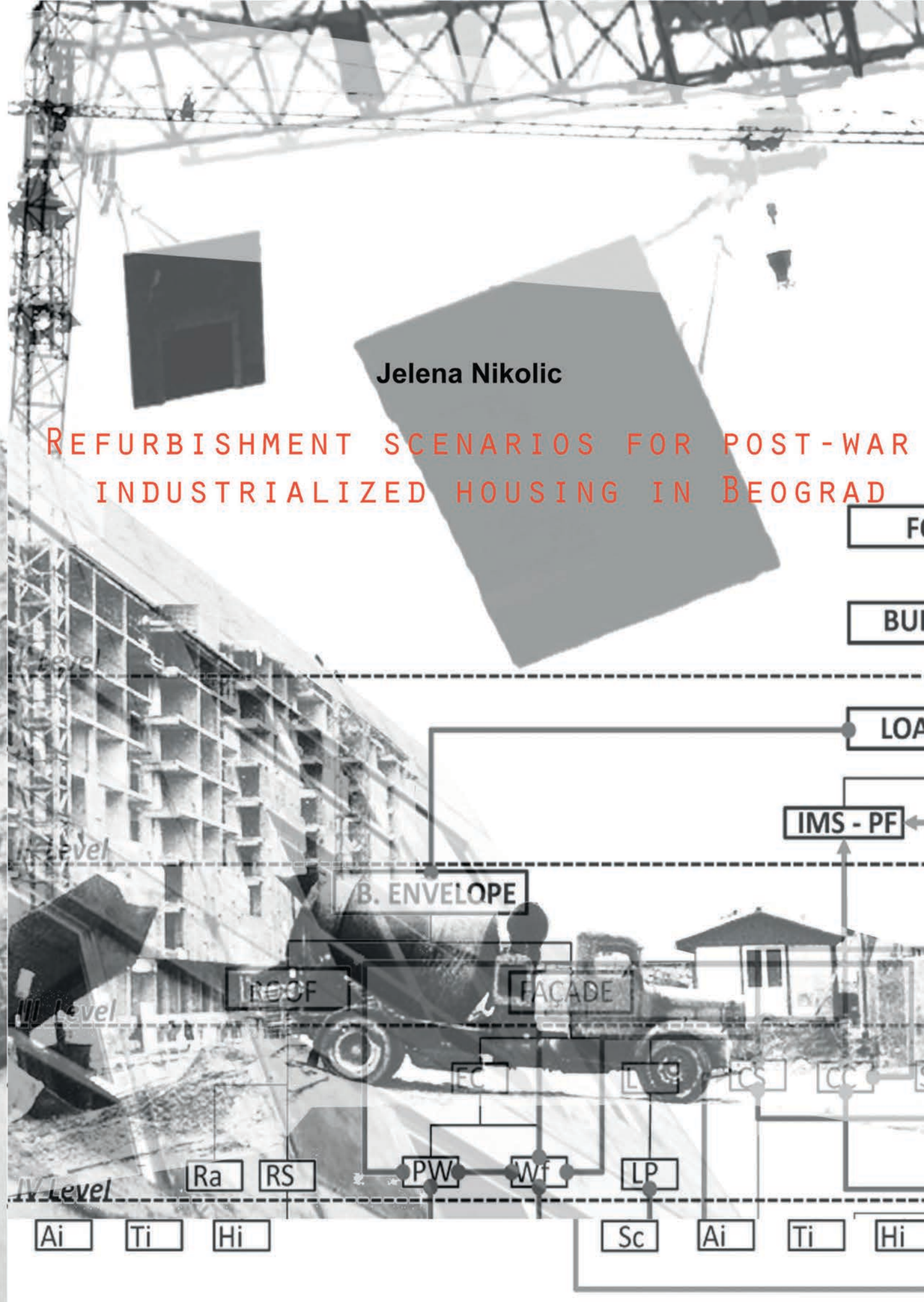
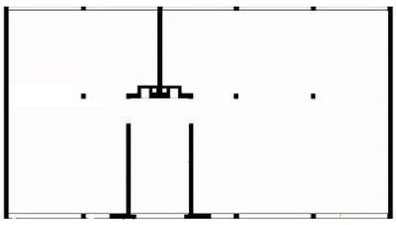
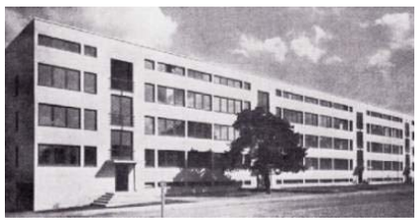


APPENDIX

APPENDIX: Evolutionary Residential Open Building Projects

1927_ **The Weissenhofsiedlung** | Mies van der Rohe | Stuttgart | Germany

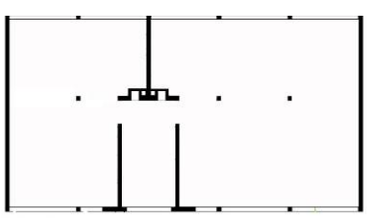


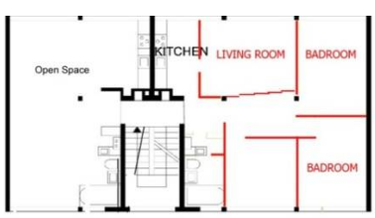


Allying flexibility with progressive technologies, van del Rohe stated that the frame construction was the most appropriate form of construction to deal with a different needs of the occupants because it allows for the building to test the greatest variety of floor plans.

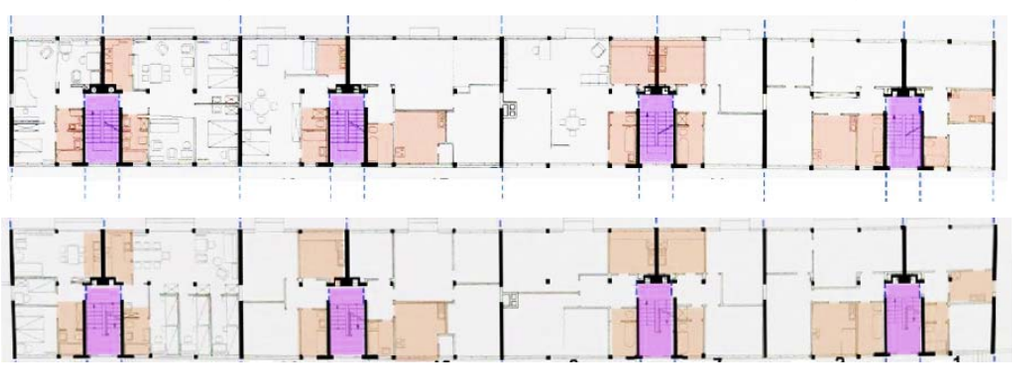
“For the present, I only build the perimeter walls and two columns within, which supports the ceiling. Everything else ought to be as free as possible.” (Mies van der Rohe)

The initial floor plan is completely “open plan” except from one or two internal load-bearing columns. This was one of the first projects of building decomposition in two levels: building parts that belong to "support" level has been separated from dwellings. Building structure is designed to support flexibility of the residential area. The dwelling units were designed before the building structure had been finished. The insertion of the new components and subsystems is possible at the “infill” level. Interior partition walls had been moved from its initial position and different dwelling’s arrangements have been realized. Figure 1c highlights the fixed points in the design (as determined by the service installations) the kitchen, the bathroom and the toilet.





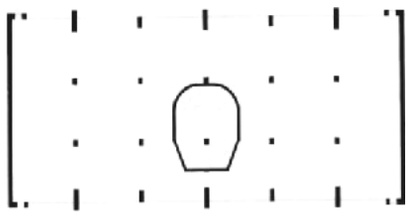
a) b)



c)

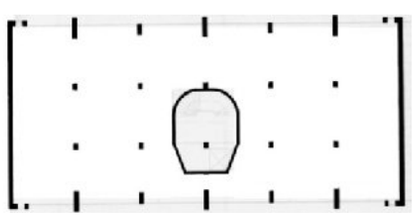
Figure 1: a)Building load-bearing structure; b)Building support and insertion of dwelling partition walls; c) Building transformations - colored surfaces highlights different dwelling`s arrangements, these transformations happened independently in time.

1952_ **Kristalbouw** | Jan Trapman | Amsterdam | The Netherlands

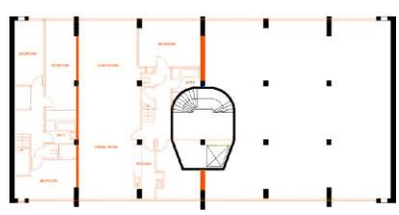


Trapman's Kristalbouw project has been considered as the base for the development of John Habraken's approach of 'supports' and 'infill' – “SI” building. The building was built as a concrete frame structure supporting lightweight floors. In the center of the volume are placed the staircases and lifts. The use and design of the building layout is left open within the support structure Figure 2. The front edge of the support structure can be used as a balcony for apartments, or as an open gallery access. The skeleton structure is the building part that is permanent (without demountable properties), but it’s is designed to be flexible for the spatial transformations of dwelling units. Deferent unit’s layout could be arranged. Finally, the residential area is limited by the inner column position. The columns in the interior space may be considered as the only boundary condition for the division of the living area.

Trapman’s project shows a range of alternatives: different ways of subdivision, various internal and external access, one-storey apartments or duplex Figure 2 c) i d). It is possible to organize one duplex by moving the light floor construction and allow the location of stairs within individual units. He also proposed that apartments could be extended sideways or upwards over time. This project clearly underlines the independent coordination rules for design of each unit and the design of the building structur.



a)



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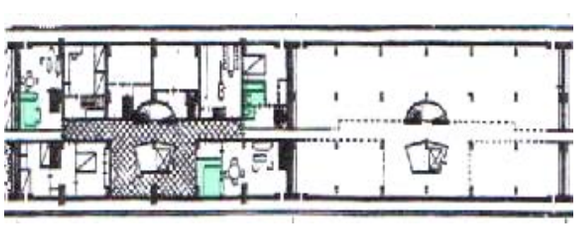

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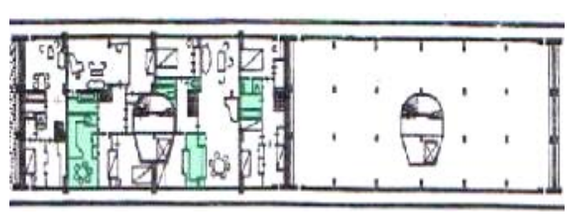


d)

Figure 2: a) Building load-bearing structure: Skeleton frame consists of columns and beams of cast-in-place concrete; b: Dwelling units arrangement: Insertion of partition walls; c,d: Housing transformations: green color highlights different unit’s changes of the bathroom and kitchen position.

1960_ **Kallebäck Experimental Housing** | Erik Friberger | Sweden

Kallebäck housing is built at the urban periphery of Göteborg. The building is design and built as SI building. Building structure is permanent but it is designed to be flexible for the transformations at the infill level. The support level deals with the load-bearing structure, vertical circulation and a few service connections. Building model is designed as a “shelve” ready for the insertion of the independent dwelling units (Figure 3,c). Each unit could be designed and changed independently from others. Each dwelling is a set on a concrete floor plate, and can have its own facade treatment and floor plan. The front of the structure forms the balcony for each dwelling that could be transformed in time. The design of the house is then based around a system of demountable partition walls, wall cupboards and doors, all simply fixed to the concrete floor salb.

a) b) c)

Figure 3: Kallebäck Building Model: a) Load-bearing structure; b) interior partitions of space; c)

The idea was that the shelves would be filled up over time. However, such was the initial idea of the scheme that all the plots were taken from the start and each of the dwellings designed more or less to their full extent. The resultant scheme still retains a sense of a set of individual volumes.

Kallebäck housing development can best be described as a shelving unit that provides individual slots for single dwellings. The building structure is designed, for the first time, as a clear span structure without internal load-bearing elements Figure 3a. Current possibility for rearrangement of dwelling partitions has been extended to all dwellings' parts including outside boundaries Figure 3b. Kallebäck primary structure (“shelve”) provides “individual sites” for single detached dwellings Figure 4. Each dwelling is set on the concrete floor slab and can have its own facade treatment, floor plan organization and even roof.

The design of the house is based around a system of demountable partition walls. All the layout plots were different and could be installed and adapt during time according the occupant requirements.

- Every dwelling unit allows a number of different distributions of dwelling functions.

Possibility to change the surface of the floor plan, either by additional construction or changes in the boundaries of units within the “support” limits.

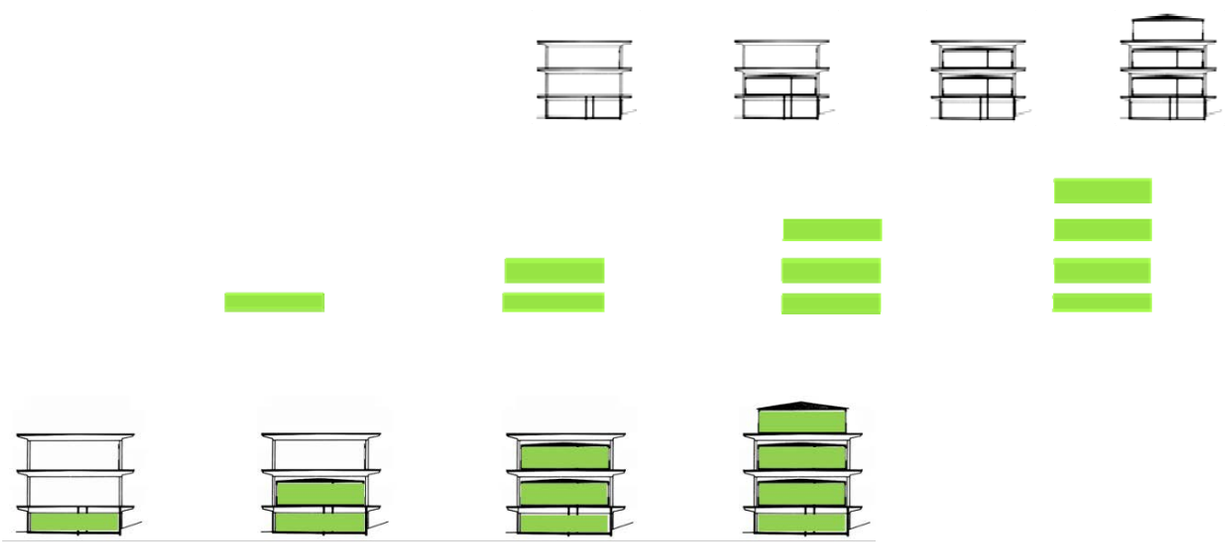
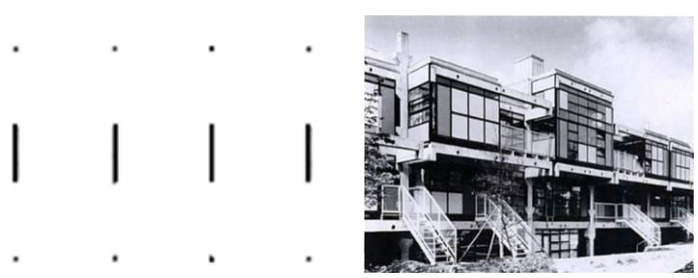


Figure 4: Kallebäck independent “infill” system

1972 _ **Terrazas en Genter Strasse** | Otto Steidle | Alemania | Munich



The residential building in Genterstrasse designed and built in 1972 is one of the best open building realizations. The flexibility is achieved with re-adjustable space to the individual units. Space and volume can be expand or deduced according to the living demands. To achieve that components had to be prefabricated and having them not permanently fix to one-another. The arrangement has been already changed several times from what it was originally.

The modules are the prefabricated reinforced concrete frames Figure 5. These frames can be merged together and multiply. Therefore columns are the keys as they share the loads and allows beams to join together to form the network. The columns also have the corbels distributed in every half-storey high. This was the new flexibility option to split level or to have 1.5 ceiling height.

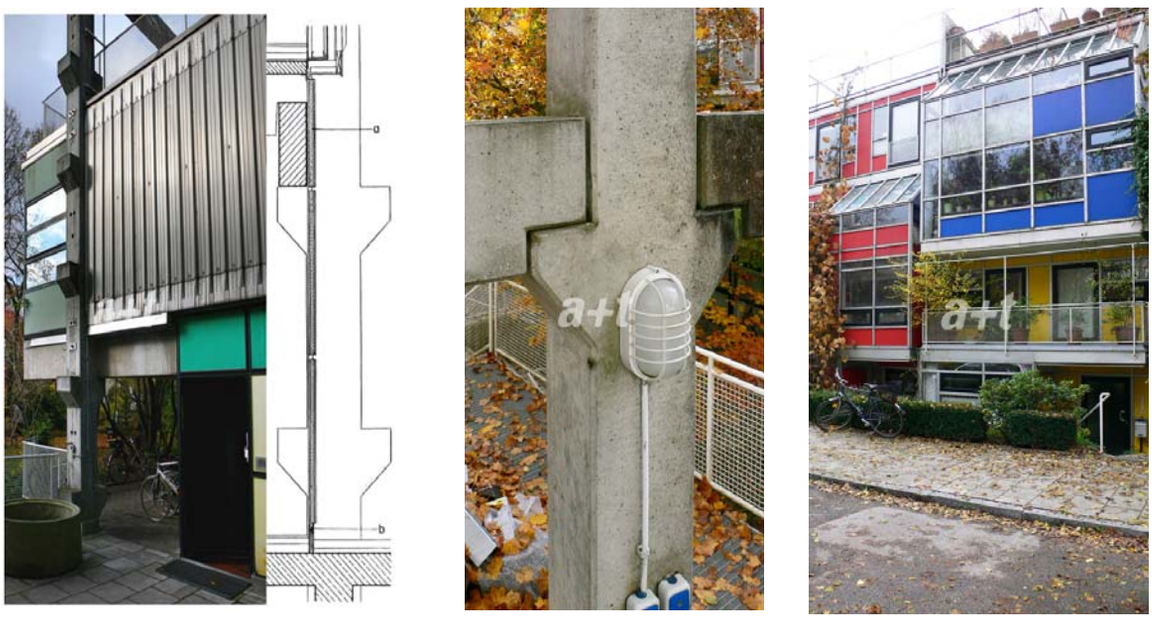


Figure 5: Genter Strasse Multifamily Building: Detaill of the concrete column with corbels

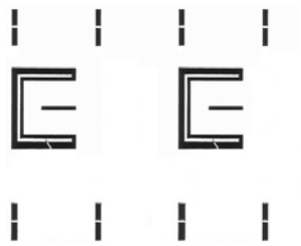
Otto Steidle applied the concrete skeleton that is presented as a simplified system of columns with longitudinal beams and supported floor panels. These frames can be combined whit different spans and multiply in both direction various times. Steidle & Partners developed IFD (Industrilized, Flexible and Demountable) model, using simple, demountable dry joints. The building model is site composed Kit-of-parts system (A-Slab and Column; B- Panels) composed of:

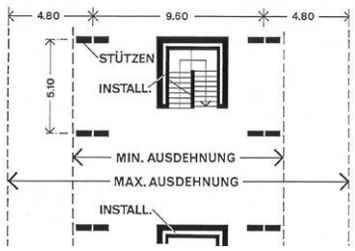
- Reinforced concrete skeleton;
- Reinforced concrete columns with corbels on every half storey with double height;
- Longitudinal down stand beams, cross beams;
- Ceiling panels and;
- Installation cores made from in-situ concrete.
-

Two main “flexibility” aspects are achieved:

- “Flexibility of the Product”- of the total building model or of some building parts-subsystems. We can consider the flexibility of the building framework to allow transformation of the dwelling unit.
- “Flexibility of the Tool”, referred to the building process to generate the flexible action according to life style changes (Richard, 2006).

1976 _ **Dwelling for Tomorrow** | Ottokar Uhl and J.P.Weber | Austria





"Dwelling for Tomorrow" was a competition project for the Open Building design and for the flexible multifamily housing. This project application was submitted with the comment that the exact number and types of apartments would only finally be determined once the future occupants had designed their respective units, and so the indicated layouts only showed one possible form of subdivision .

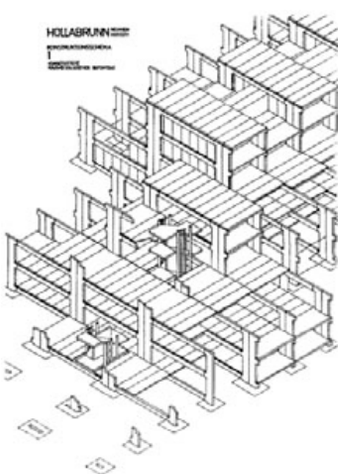


Figure 6: Dwellings for Tomorrow building model

The load-bearing structure consists of prefabricated LECCA concrete columns and beams, with a construction span of 5.1 and 9.6 meters, and in-situ reinforced concrete slabs/ceilings (Figure 6). The only fixed element in plan is the staircase whose enclosing walls works as the shear walls and services blocks. Within these limitations, partition walls can be placed anywhere.

The occupants were able to choose: the arrangement of the walls within the support structure of the dwelling units; the size of the dwellings by determining the position of the façade elements; the

subdivision of the dwelling into rooms, which also included kitchens and bathrooms; the number, type and position of windows and doors; and the finishing of the dwellings.

1984_ Next21 experimental project, Osaka, Japan

The Next 21 multifamily housing in Osaka is considered the best Open Residential Building. The building has six floors above ground and the basement. The building reinforced skeleton was finished in September 1993, and the design of the units continued until December 1993. The building consists of 18 individual dwelling units, which were designed by 13 different architects in different time distances (Kim & Brouwer, 1993). The Next 21 is based on the two main concepts: the systems' building and the independent technical levels. Support-Infill (SI) Building Model is based on permanent “support” structure, and demountable “dwelling units” (Figure 7).

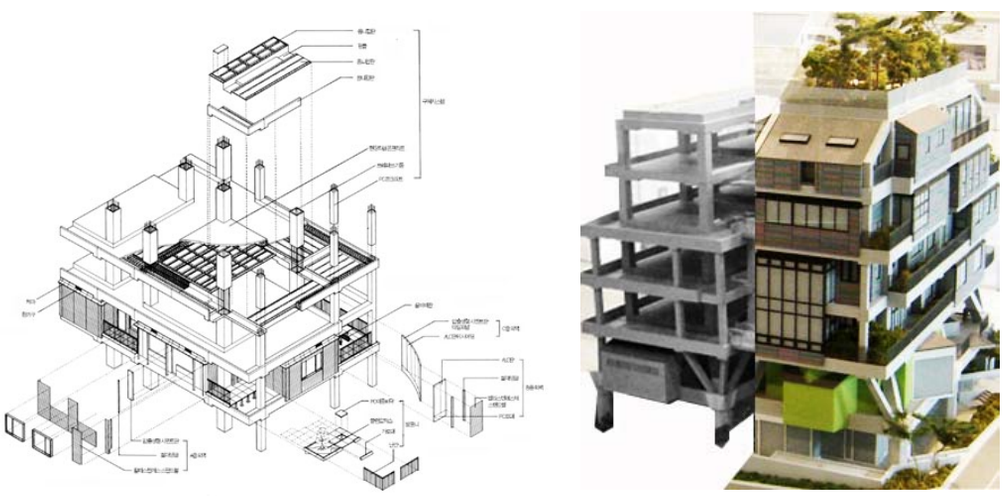


Figure 7: Next 21Building model

The support is designed to be permanent, and the infill, which has a shorter life is designed to be easy transformable. The support-infill division is done according to the different life span and production methods of the building parts. Consequently, one of the key design tasks was to synthesize a number of building subsystems and their components into one integrated building.

To facilitate this separation the base building offers not only empty space for dwellings, but also a two feet double floor that can be reached by detachable floor panels and contains the infrastructure of utilities like gas, water, and energy as well as waste drainage. The dwellings can use the double floor space to connect to these utilities and extend them throughout the individual dwellings according to hierarchy in the utility systems (Habraken, 2003).

For the “infill” level is applied “Kit of parts” system (Figure 7). “Kit-of-parts” system refers to the study and application of building system, where components are pre-designed / pre-engineered /pre-fabricated to be installed in joint-based (linear element), panel-based (planar element), module-based (solid element).”*(Wikipedia.* Kit-of-parts system is a set of components and evidently is the most appropriate

type of construction for the industrialized buildings to achieve flexibility. The different Kit-of-parts subsystems are applied in building model and can be assembled and taken apart in a variety of ways. The building components are divided in two groups: long-life elements of the load-bearing structure (columns, beams and floors), and short-life elements in both communal and private areas (partition walls, services and equipment), which can be modified without any influence on the integrity of the “support” system.
Overview of the mayor subsystems in the Next 21 building model are: load-bearing system, building envelope, service, "infill".

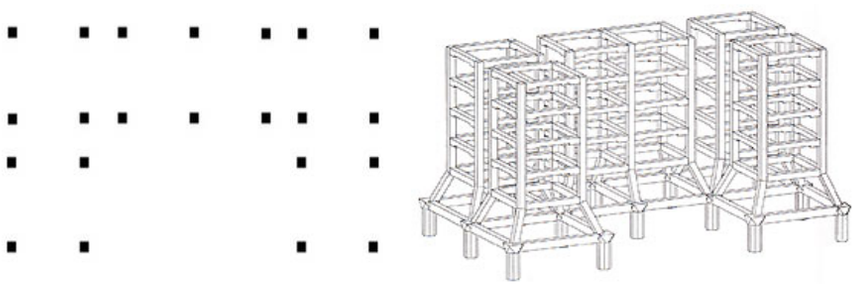


Figure 8: Next 21 Building structure: left-plan of load bearing concrete skeleton; right: axonometric view

The structure (Figure 8) is the only part of the building that is permanent, but is designed and constructed as demountable system. The building frame consists of the columns and beams of cast-in-place concrete. The floors were constructed using thin precast concrete panels. From the third floor, there are six independent structures which are single-span towers of columns and beams, each 7.2 meters (Figure 8). Between these structures are zones 3.6 meters wide which are provided with low slabs. The floor-to-floor height is 3.6 meters and the floor-to-floor height of the lower level is 4.2 meters. The final form is a 3D structure designed and built to support independent design and transformation of individual dwelling.

Figure 9: Common building services (left); dwelling unit services /vertical section (right)

In the Next 21 the total service system is divided in two parts. Communal services are placed in raised floors and suspended ceilings in the marginal zone (Figure 9). It is important to differ for any system, one zone that allows easy access and control. Communal services are distributed inside the communal zone (Figure 9).
The building mechanical systems have shorter life from the building structure. Therefore, the shorter life span of the pipes and ducts components of mechanical systems has a major impact on the life span of the building. Because of these, mechanical systems were designed to be easily accessible. The large vertical shafts are located in the building “margin” zone (Figure 9). Pipes and wiring are led from these shafts,

underneath the common corridors to each unit. This concentration of the vertical shafts is easily accessible for repair or replacement of the components. Horizontal pipes and wirings are placed in the corridor. When different parts and /or subsystems have to be renewed, panels or floor plates allow easy access (Figure 10). Building plumbing and cladding system may be transformed according to different requirements for the replacement and repair. Mechanical and electrical wirings and façade cladding are demountable components.

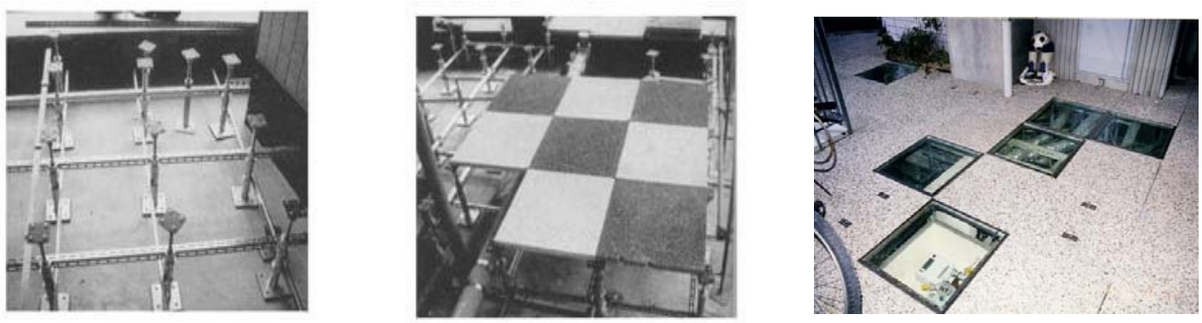


Figure 10: Wiring and piping for gas, water and electricity are located in raised floors.

In the cladding system of Next 21, the exterior walls are treated as a cantilever panels for skeleton structure enclosing (Figure 11). This allows easy replacement of the panels to be done from the inside, without the scaffolding. The exterior cladding is installed to be easily replaceable, and as the independent system on the "infill" level. The geometric variation of the individual unit facades was coordinated through the incorporation of design rules for the exterior walls and the modular arrangement of the windows.

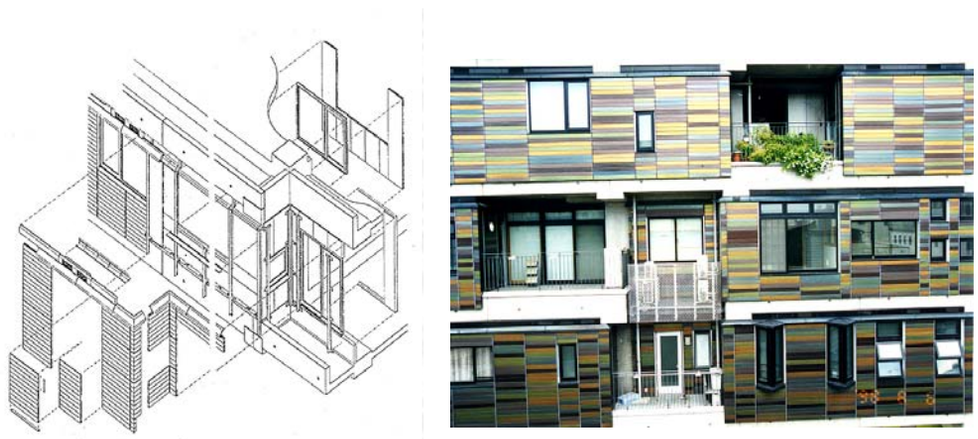


Figure 11: Next 21 Cladding system

Providing aluminum panels and a variety of windows and doors, facades can be installed and taken apart without need for outside scaffolding, thus enabling easy adaptation later on. Multi-unit building facades are generally treated as “support” level elements. Next21 extended the concept of the facade to be a part of the “infill”. Design of the individual dwelling includes arrangement of its industrially-produced “kit of parts façade”, which can be modified. Overall technical transformation of the building’s façade is made

possible by the design of the façade system, the components' compatibility and its rules of modular and positional coordination in the assemblies.

On the Figure 12 is presented one dwelling unit and its independent functional and technical levels.

Figure 12: Next21: Subsystem at the “infill” level: **A** - Structural module; **B** - Unit cladding, doors and windows; **C** - Interior partitions, fittings, interior finishes, the doors and windows; **D** - Dwelling services / (ducts, pipes, and wiring of mechanical systems are placed in floor or ceiling spaces, which allow flexibility for the location of kitchens and bathrooms in dwelling units.; **E** - Equipment, furniture.

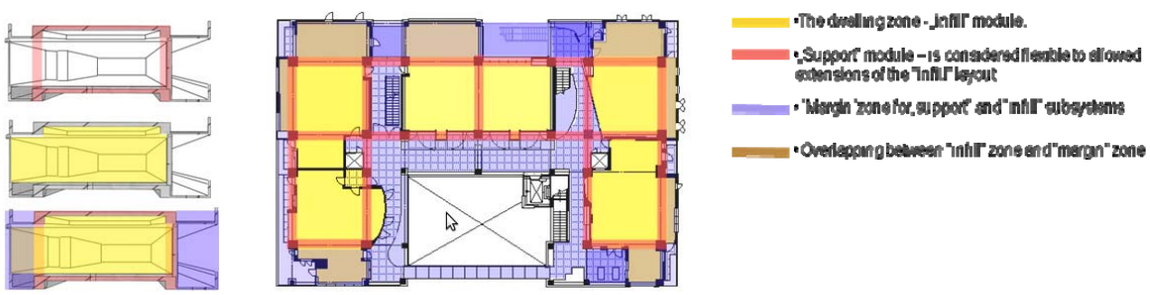


Figure 13: Functional distribution in “zones and margins” in the building layout

The dwelling zone includes three different sizes of construction modules. The main module consists of the unit 7.2 meters x 7.2 meters, and the sub-modules are 7.2 meters x 3.6m or 7.2 m x 1.8 m. The corridor zone 3.6 meters wide includes stairs, corridors. The functional decomposition of the building layout is applied for the clear separation of functions in “zones and margins” (Figure 13).

The integrated system is assembled from a series of independent subsystems. This decomposition into the mayor building subsystems allows for a building that is technically-flexible, in which components can be easily replaced at the end of their service life. The building system decomposition corresponds to the functional decomposition and the spatial changes in the building layout. The key design tasks are to synthesize a number of building subsystems and their components into one integrated building based on the components exchange and independence.

The IFT methodology was established first for the adaptability of the dwelling unit at the infill level. Appling IFT method on the infill level is achieved the in-built flexibility of dwelling unit for constant change (Figure 14). The industrial, flexible and transformable “infill” system allowed the adaptability of the space, processing joining features of the factory-made components and subsystems. All the factory-made components or sub-systems are designed for the easy installation and decomposition without any

partial or total demolition. Transformation of the dwelling unit layout resulted with the changes of all “infill” subsystems including the dwelling shall. In the Figure 14 may be observed all dwellings' changes while building structure keeps permanent.

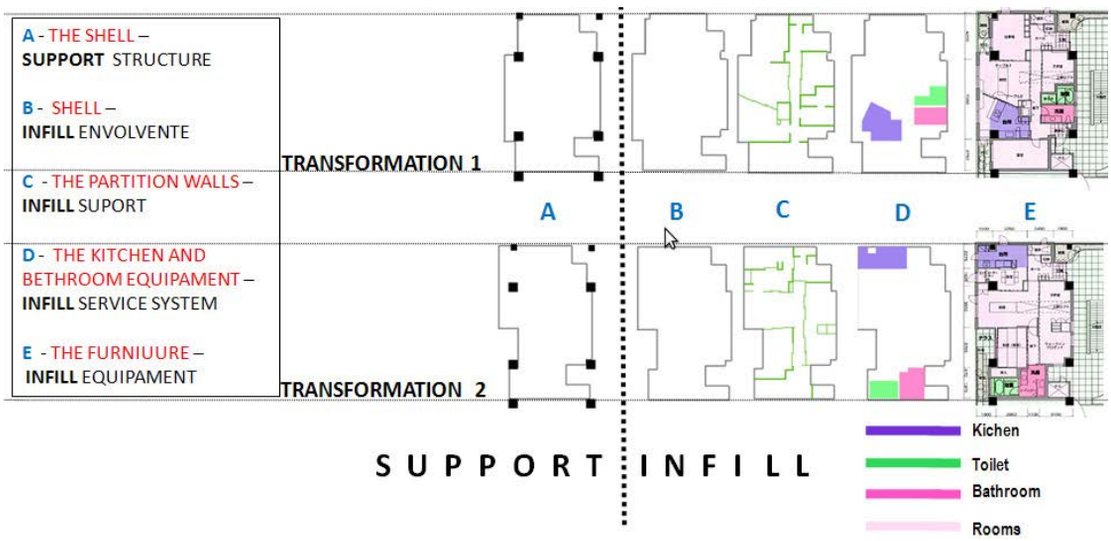


Figure 14: Two- transformation of dwelling unit No.302

Here, the building model is divided into four main functional and technical sytsems according to components and subsystems life circle. They are manufactured as the separate systems and modules so that outer walls, kitchens, bathrooms, toilets, and gardens can change its positions. The building elements are divided into two groups: i) primary structure - long-life elements with common services (columns, beams and floors), and ii) secondary structure in private areas (partition walls, building facilities and equipment). This form of ‘future proofing’ is particularly relevant to the provision of services which tend to be both, continually updated and protected against obsolescence.

We believe that, in our case, for the period of post-war regeneration project, the application of industrialization in developing a flexible frame structure for housing was really successful and respect both housing design and building technology.

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APPENDIX: NEXT 21 – Open Building Pilot Project

This work highlights the “Open Building “strategies applied to NEXT 21 prototype multifamily housing complex

NEXT 21 - Multifamily Housing

Architect: Yositika UTIDA, Shu-Koh-Sha Architectural and Urban Design Studio
Construction Coordination: Seiichi FUKAO
Design System Planning: Kazuo YATSUMI and Mitsuo TAKADA
Exterior Façade System: Seiichi FUKAO
Modular Coordination System: Seiichi FUKAO
Owner: Osaka Gas Corporation
Dwellings: 18
Support Construction: Reinforced Concrete Skeleton, Newly Developed Façade System
Infill Provision: Experimental System

Two concepts: Building System / Building Levels

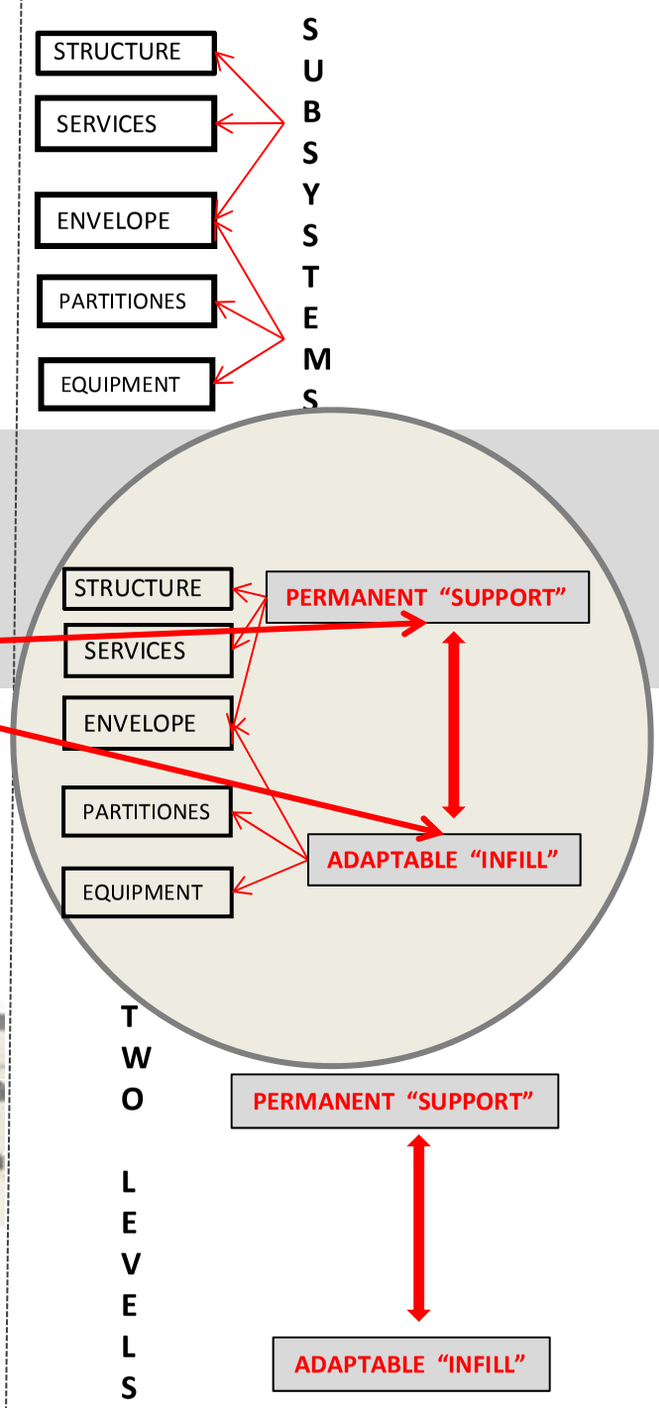
1 - SYSTEM BUILDING APPROACH- an integration system assemblies from a series of independent subsystems

2 - TWO LEVELS BUILDING - “SUPPORT” & “INFILL”

NEXT 21

“Building System” method sets up the system compound of many subsystems.

SI System



“Kit-of-parts” building system

•This “Kit-of-parts building system takes account particular life span of each component.

•Building components are divided into two groups: long-life elements that provide the “support” structure (columns, beams and floors), and short-life elements in both communal and private areas (partition walls, services and equipment), which can be modified without any influence on the integrity of the “support” system.

• four main subsystems :

NEXT 21

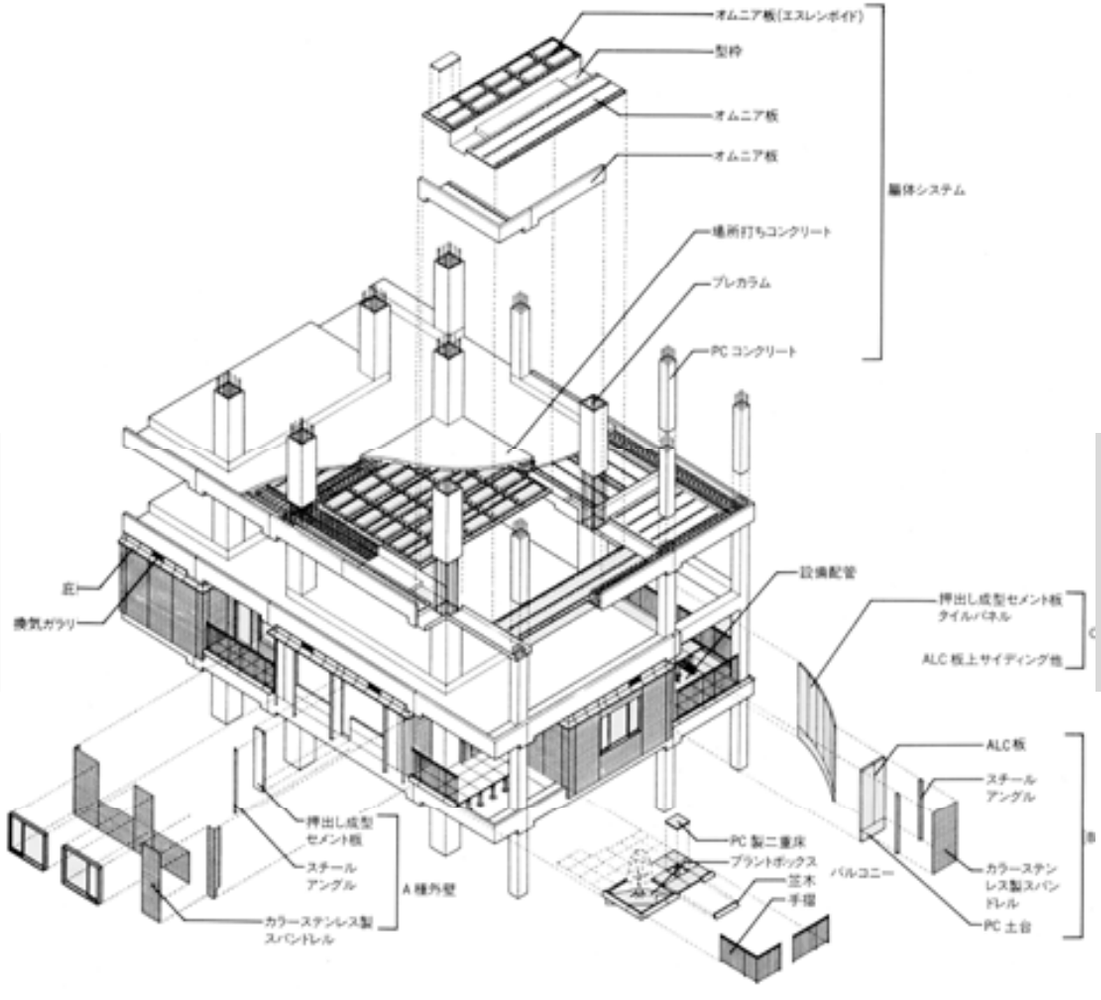
1- STRUCTURE
2- CLADDING
3- INFILL
4- SERVICES

Prototype Multi-Family Housing

•prefabricated products made in factories and/or customized parts made on site are used in “Kit-of-parts” building system;

•rules of integration to make the factory-made component and costumized product compatible with each other;

•independent subsystems make easy and economical the replacement of component parts during occupancy and use;

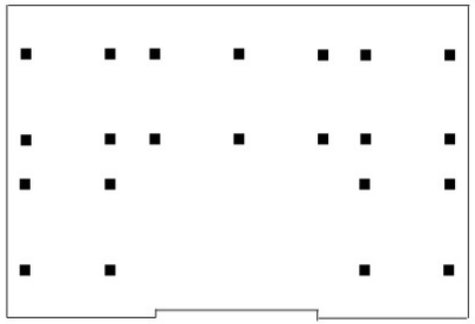


NEXT 21 Kit-of-parts” building system

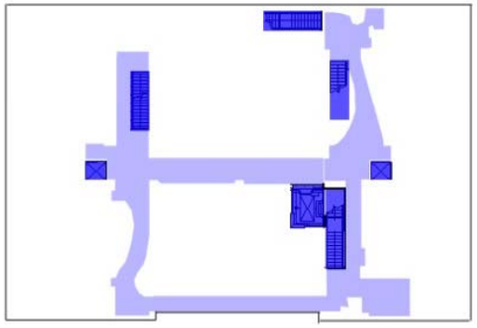
“Building System “ for NEXT21

OVERVIEW OF THE MAJOR SUBSYSTEM THAT COMPOSES THE OPEN BUILDING SYSTEM IN NEXT 21

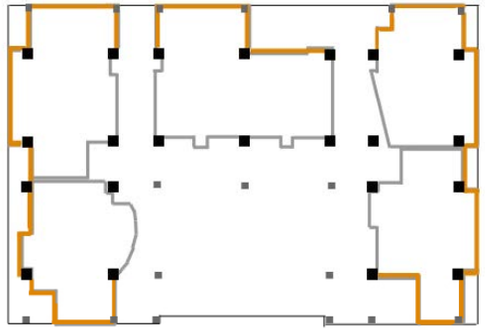
STRUCTURE



PLUMBING



CLADDING



INFILL

NEXT 21

•INTEGRATED DESIGN SOLUTION

-independent subsystems

-disassembly of its component part

• a number of building subsystems and their components were synthesize into one integrated building;

•this synthesis of building elements is based on the different life circles and production methods of the subsystems and components. The decomposition of the building into a collection of subsystems allows for a building system easy disassembly of parts as its life expires.

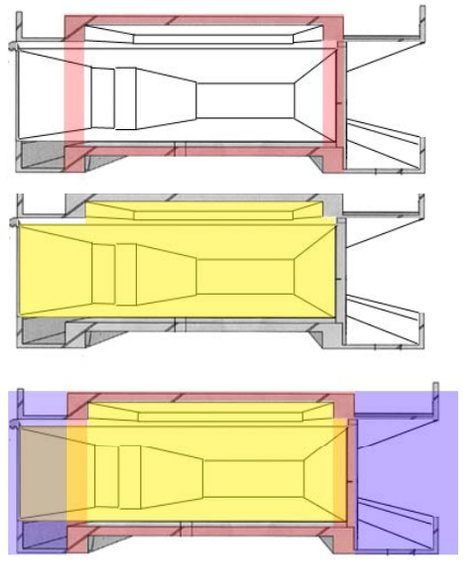
•after the end of building’s life, the disassembly of its component part is possible, and useful parts could be easily recycled or reused;

“Open” Building design – “marginal zone” as a potential for building transformation

The NEXT 21 project is organized around three zone types, each based on a 90cm grid:

•The house zones include three different sizes of modules. The main modules consist of units 7.2 meters x 7.2 meters, and the sub-modules come in two units 7.2 meters x 3.6 meters or 7.2 meters x 1.8 meters.

•The street zones include stairs, corridors, and voids and are 3.6 meters wide. The public zones consist of 10.8 meters x 10.8 meters or 10.8 meters x 9.6 meters.



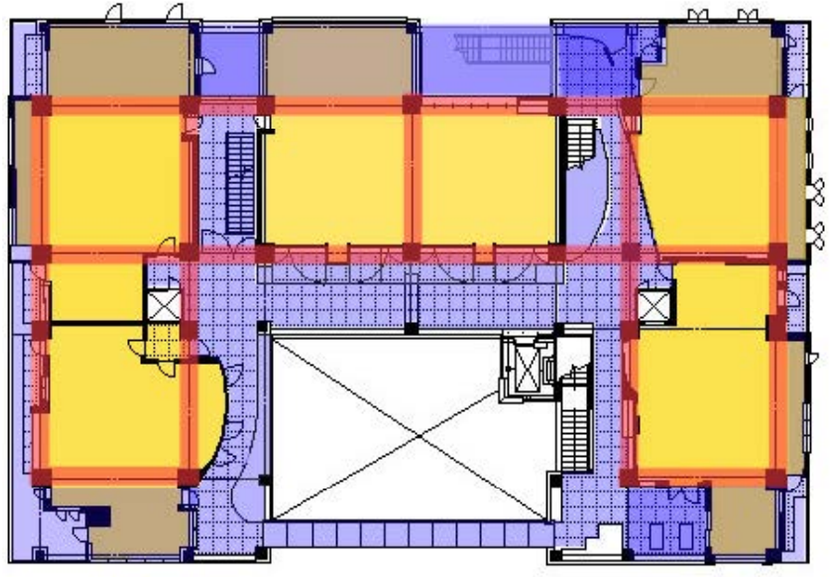
NEXT 21

- •the dwelling zones – „infill“ module
- •„support“ module
- • corridor zone as a marginal zone for „support“ services subsystems
- • Overlapping between “infill” zone and “margin” zone.

•Distribution of functions for clear organization in zones and margins.

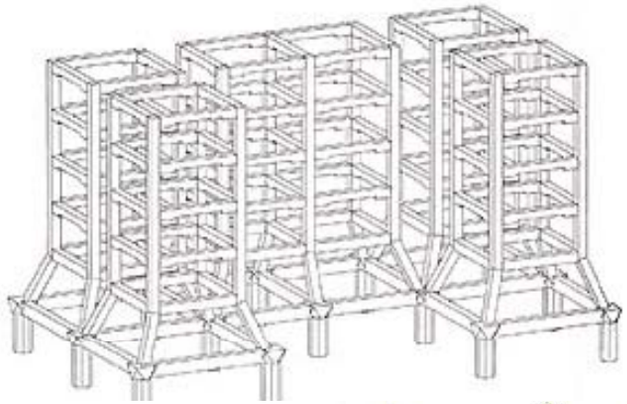
•Use the „space layers“ at the design stage for distribution of function.

•Establish the difefrent zones for the differnet functions in housing.



The structure is the only part of the building that is fixated.

-SUBSYSTEM COMPONENTS: column an beams and concrete floor slabs; the building frame of columns and beams were made of cast-in-place concrete**.**



NEXT 21

1- STRUCTURE
2- CLADDING
3- INFILL
4- SERVICES

•From the third floor up, there are six independent structures which are single-span towers of columns and beams, each 7.2 meters square in span.

Between these structures are zones 3.6 meters wide which are provided with low slabs. As a result, there are parts of the floor in each upper level that are lower than the other areas. These areas provided the space for pipes and wiring under the raised floor. The floor-to-floor height of the upper levels is 3.6 meters.

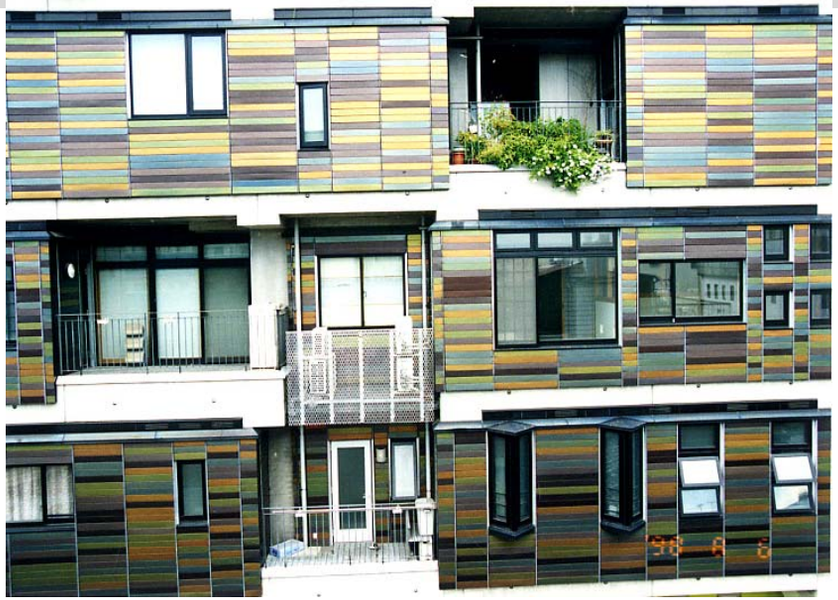
As previously mentioned, every four columns on the upper floors are consolidated into one column on the lower floors. This creates larger spans (10.8 meters x 10.8 meters and 10.8 meters x 9.6 meters) on the lower.

In the cladding system of NEXT 21, the exterior walls are treated as a cantilever panels placed outside from skeleton structure. This allows changing of the panels to be done from the inside, without the need for scaffolding.
The perimeter walls fit into a 150 millimeter wide band, and heat insulation material and a stainless exterior finish are affixed to the outside of the walls.
THE EXTERIOR WALLS ARE:
-Installed to be easily replaceable, and they are treated as an independent system on the infill level.
-The geometric variation of individual unit facades was coordinated through the incorporation of design rules for the exterior walls and the modular arrangement of the windows.
-The stainless finish of the exterior walls was arranged in coordination with the window components to give the building a unified appearance from the street.

NEXT 21

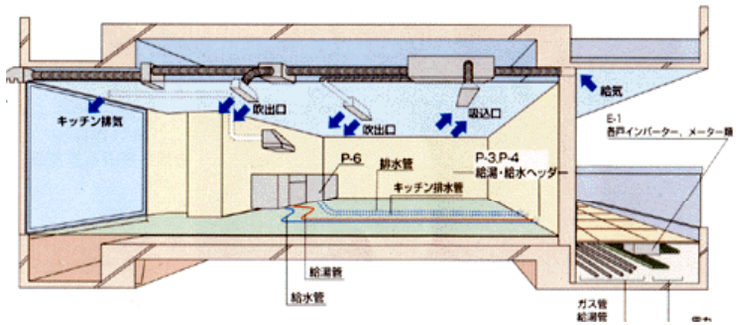
- four main subsystems :

1- STRUCTURE
2- CLADDING
3- INFILL
4- SERVICES



“SUPPORT”-”INFILL” SERVICES

The structural plan and the plan of the mechanical systems are coordinated so that pipes and ducts do not need to pass through the walls, floors, and beams of the building frame. Each unit is equipped with hung ceilings that provide a space for air conditioning ducts and equipment.

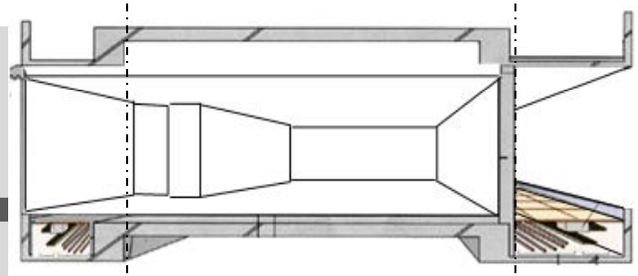


“SUPPORT ZONE”
“INFILL “ SERVICES

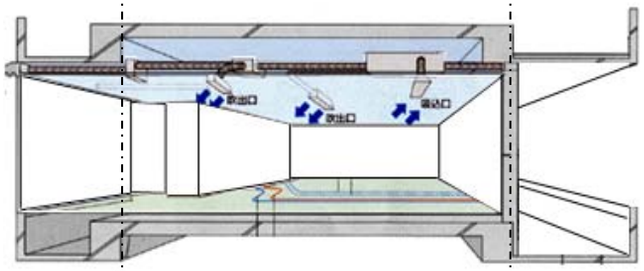
“SUPPORT “SERVICES MARGEN ZONE”

“SUPPORT SERVICES MARGEN ZONE”

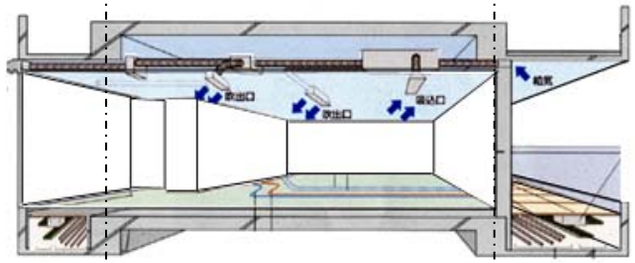
NEXT 21



MAYOR LEVEL OF “SUPPORT” Services



SUBLEVEL OF “INFILL” Services



In the NEXT 21 the total service system is divided in two groups:

•Ccommunal services are placed in raised floors and suspended ceilings in the marginal zone;
•Unit services belong to every individual unit and are supported by the mayor system. It is important to differ for any system, one zone to allow easy access and control. Communal services should be distributed inside the communal zone.
The NEXT 21 building system allow adaptability to be executed at the level of “SOPPORT” Services without disturbing the level of unit service subsystem.

A B C D E

NEXT 21

• four main subsystems :
1- STRUCTURE
2- CLADDING
3- INFILL
4- SERVICES

“infill” system - an integration system assembled from a different independent subsystems.

THE INFILL CONSIST OF:
•the unit partitions,
•fittings, interior finishes, the doors and windows,
•the mechanical equipment within the individual units.

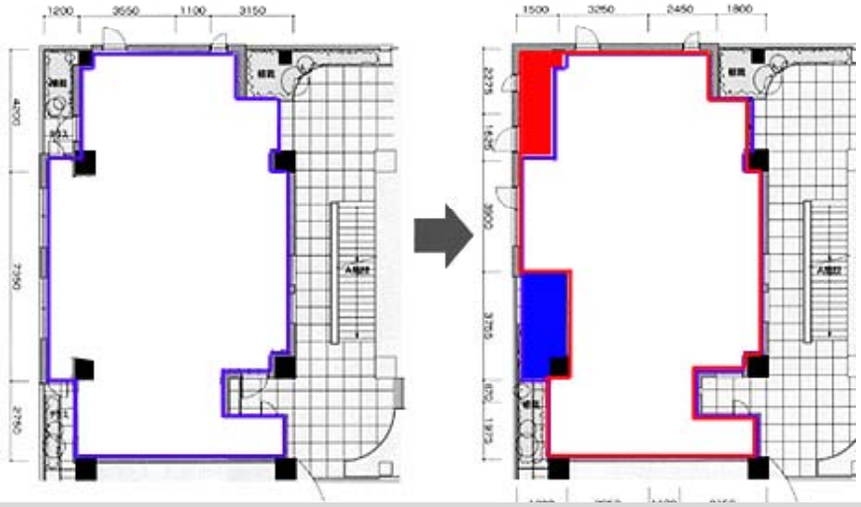
A - THE INFILL– **SUPPORT** MODULE

B - SHELL – **INFILL** ENVOLVENTE

C - THE PARTITION WALLS – **INFILL** PARTITIONS

D - THE KITCHEN AND BETHROOM EQUIPAMENT – **INFILL** SERVICE SYSTEM

E - THE FURNIUURE – **INFILL** EQUIPAMENT



NEXT 21

Kichen

Toilet

Bathroom

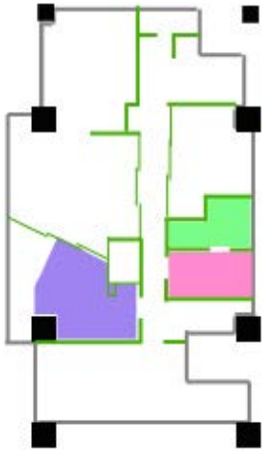
Rooms

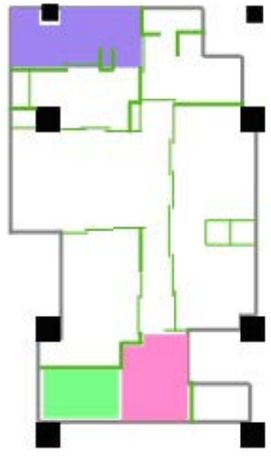
« INITIAL FLEXIBILITY » for “choice” in the design stage – 18 different typologies for individual family life style

« IN –BUILT FLEXIBILITY » an opportunity ***FOR ADAPTABILITY***
- “detachable unit” subsystems are completely independent from support structure and may adopt different modification of the unit layout.

« FULL POTENCIAL FLEXIBILITY » for full potential
of dwelling for constant change – “detachable unit “ transformations over time.

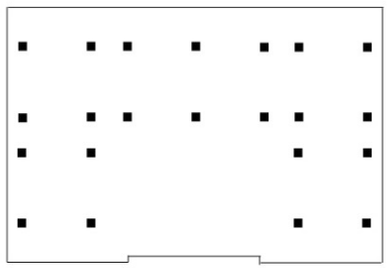
« PERMANENT FLEXIBILITY» for “change” over time differs – “support” and “infill” transformations.



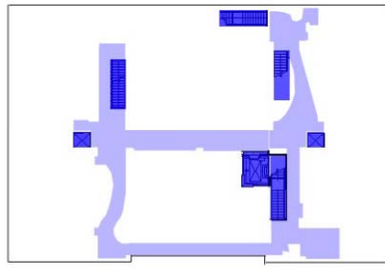


IFT - Industrialized, Flexible, Transformable building system

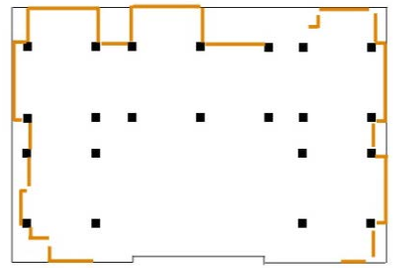
IFT method applied at the "INFILL" level



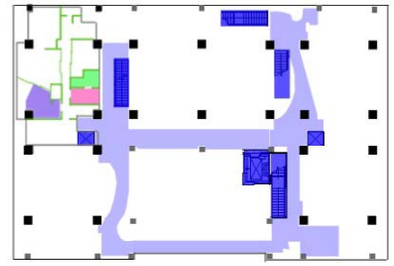
STRUCTURE



PLUMBING



CLADDING



INFILL

Kitchen

Toilet

Bathroom

Rooms

A - THE SHELL –
SUPPORT STRUCTURE

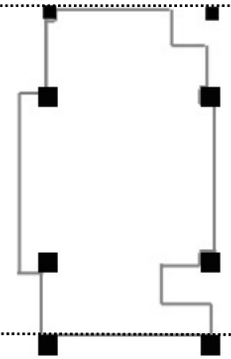
B - SHELL –
INFILL ENVOLVENTE

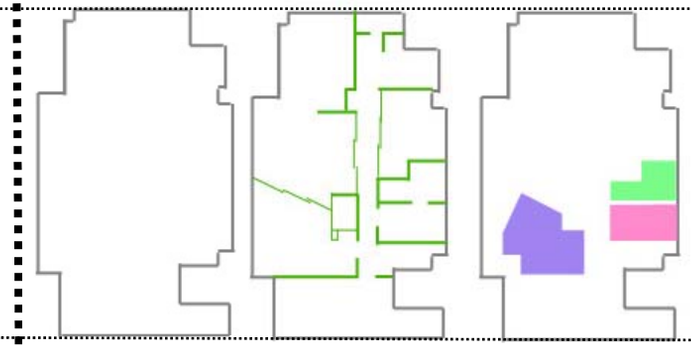
C - THE PARTITION WALLS –
INFILL SUPORT

D - THE KITCHEN AND BETHROOM EQUIPAMENT –
INFILL SERVICE SYSTEM

E - THE FURNIUURE –
INFILL EQUIPAMENT

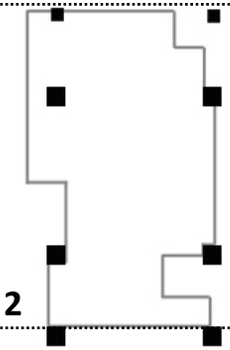
TRANSFORMATION 1

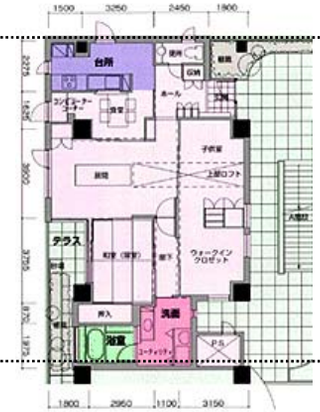




A **B** **C** **D** **E**

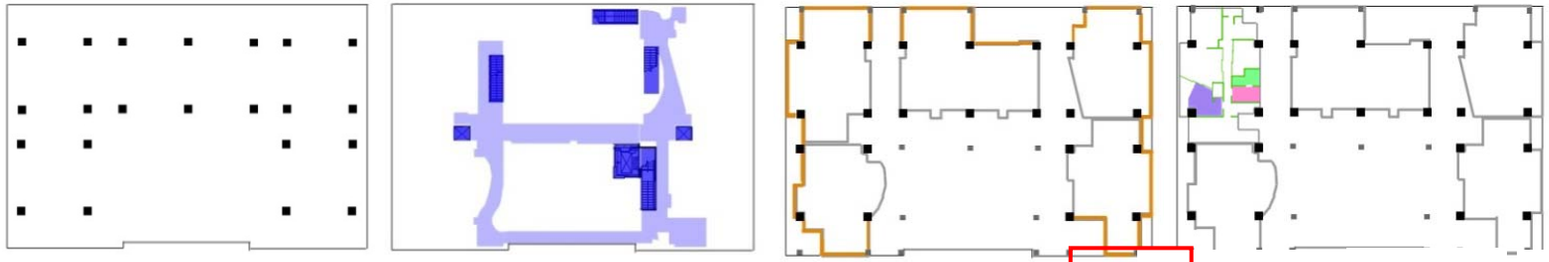
TRANSFORMATION 2





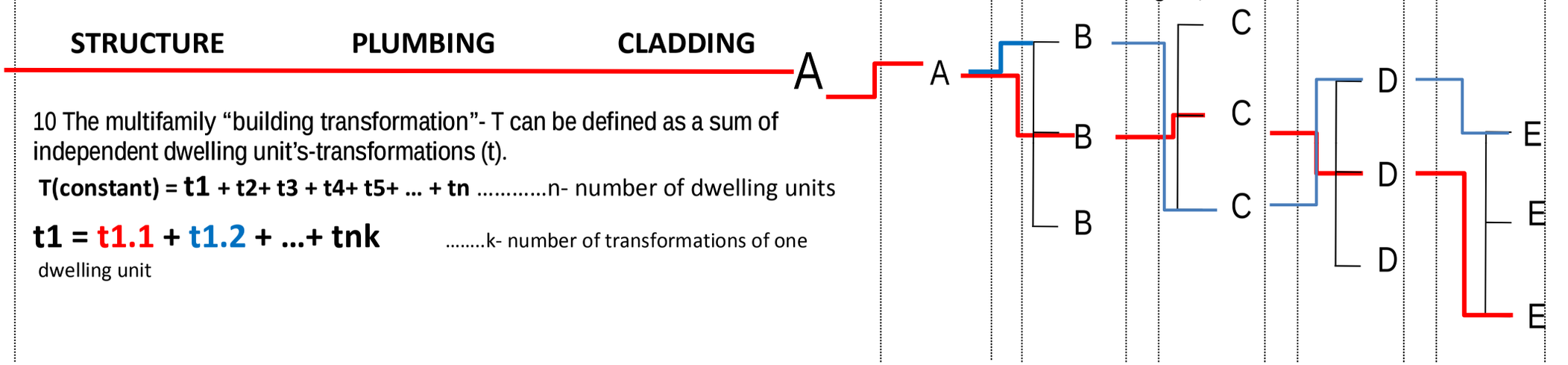
SUPPORT **INFILL**

STRUCTURE **PLUMBING** **CLADDING** **INFILL**



Subsystems at the “support” level are independent. Concrete skeleton is demountable beam-column system considered as a permanent structure. Building plumbing and cladding system may be transformed according to different requirements for replacement and repear. Mechanical and electrical wirings , and façade panels are demountable components.
Dwelling units were placed in the support functional zone and belong to “infill” level . At the “infill” level are distinguished 4 independent subsystems : DWELLING SHELL(B), INTERIOR PARTITION WALLS (C), KITCHEN AND BATHROOM EQUIPAMENT (D), FURNITURE (E).
Urban site is a condition for permanent building structure. Building structure – skeleton framework is designed as a flexibly boundary for dwelling unit transformations. In the skeleton frame, all dwelling unit transformations are independent in time and space.

Fig: t1, t2 – DWELLING UNIT TRANSFORMATIONS

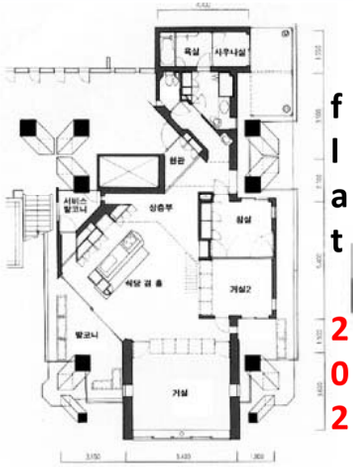


10 The multifamily “building transformation”- T can be defined as a sum of independent dwelling unit’s-transformations (t).

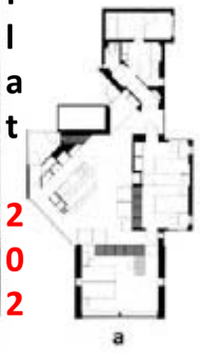
T(constant) = t1 + t2+ t3 + t4+ t5+ … + tn ……n- number of dwelling units

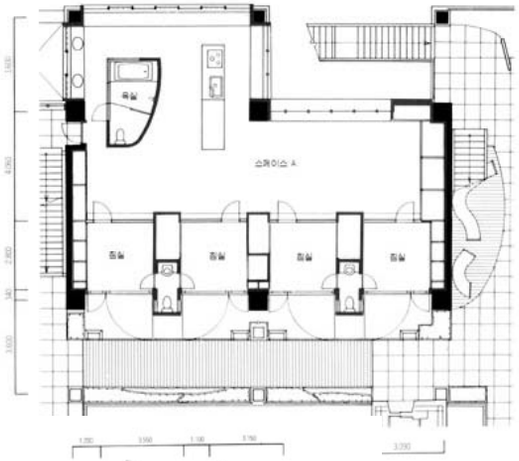
t1 = t1.1 + t1.2 + …+ tnk ……k- number of transformations of one dwelling unit

TRANSFORMATIONS AT THE "INFILL" LEVEL OF DIFFERENT DWELLING UNITS



flat 202





flat 303

flat 402

APPENDIX - **Block No. 2: Tower and Condominium building**

Block No. 2_Tower and Condominium building

Figure: Topalović, M., & Kucina, I. (2010).
From planed to unplanned city: New Belgrade's transformations.

Block No. 2_Tower and Condominium building

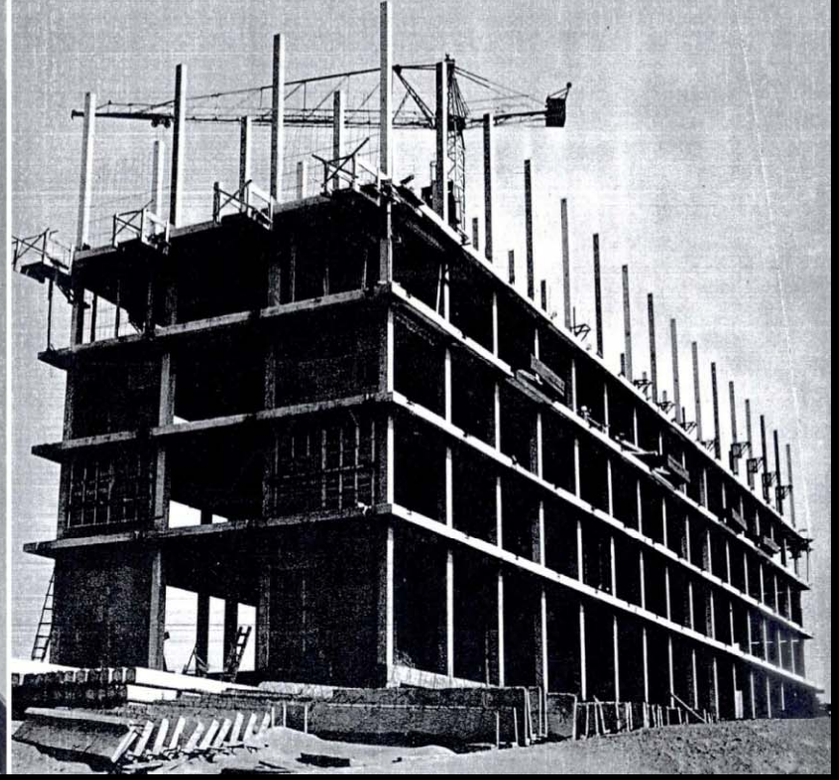
Figure: Topalović, M., & Kucina, I. (2010). *From planed to unplanned city: New Belgrade's transformations*.

Block No. 2_Tower building _ Fundations

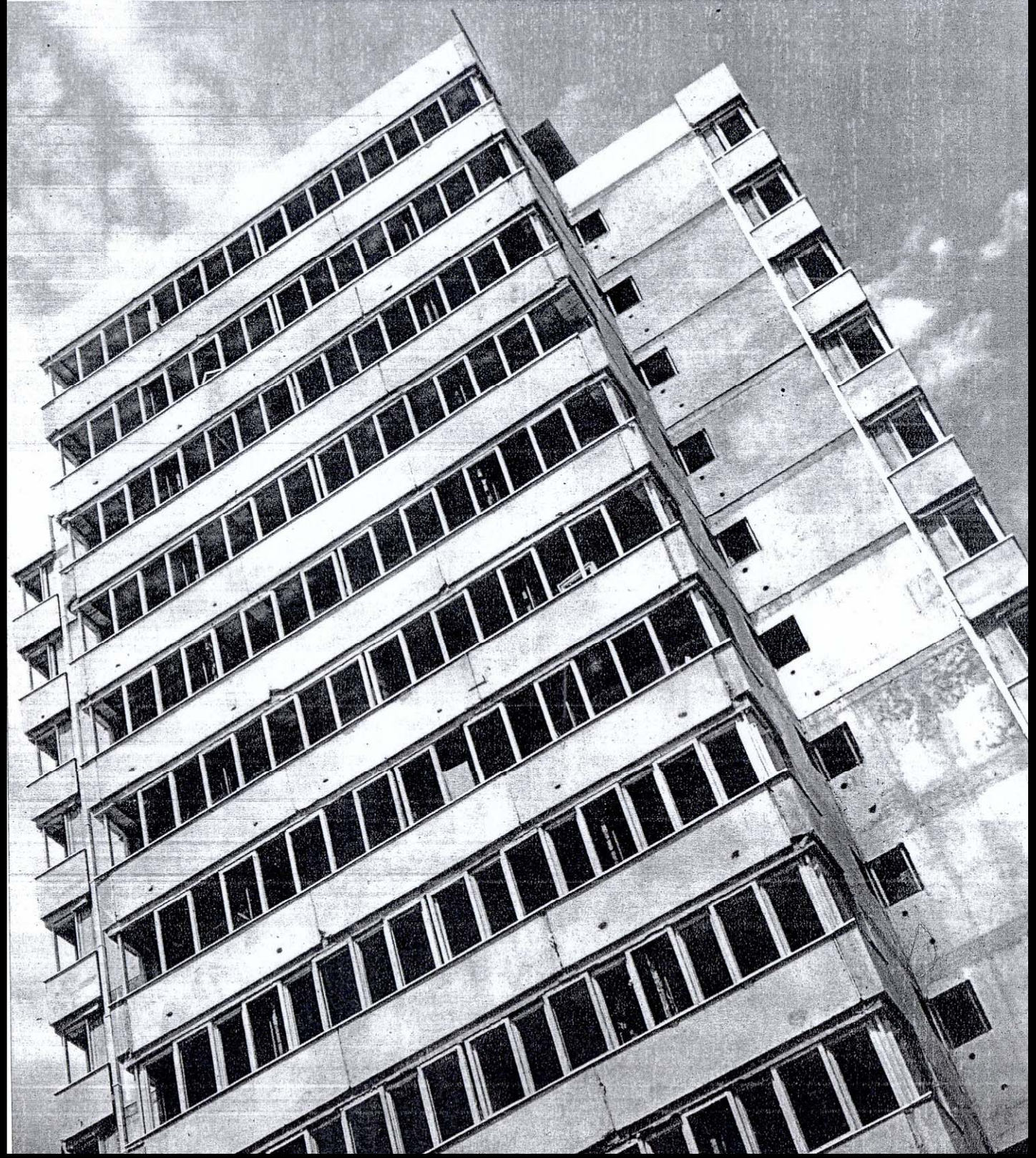
Figure: [illegible]vić, M., & Kucina, I. (2010). *From planed to unplanned city: New Belgrade's transformations*.

Block No. 2_Tower building _ IMS skeleton system: construction in progress (columns slabs and shear walls)

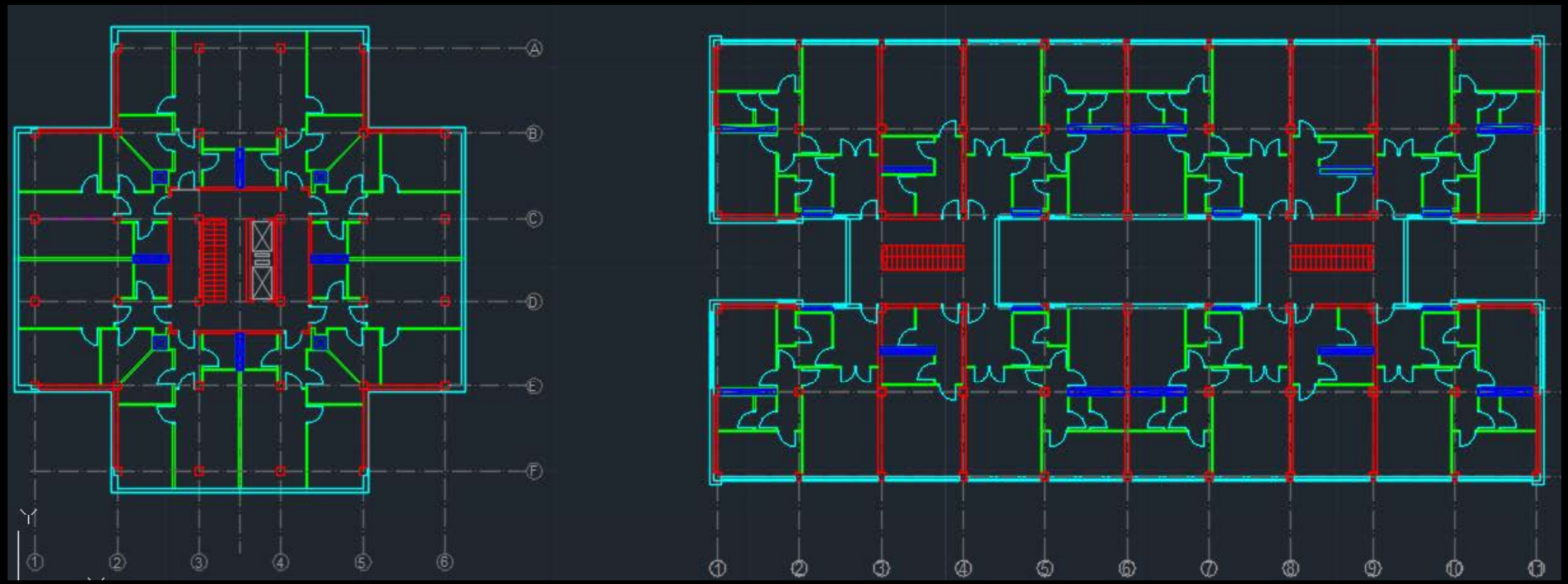
Figure: Topalović, M., & Kucina, I. (2010). *From planed to unplanned city: New Belgrade's transformations*.



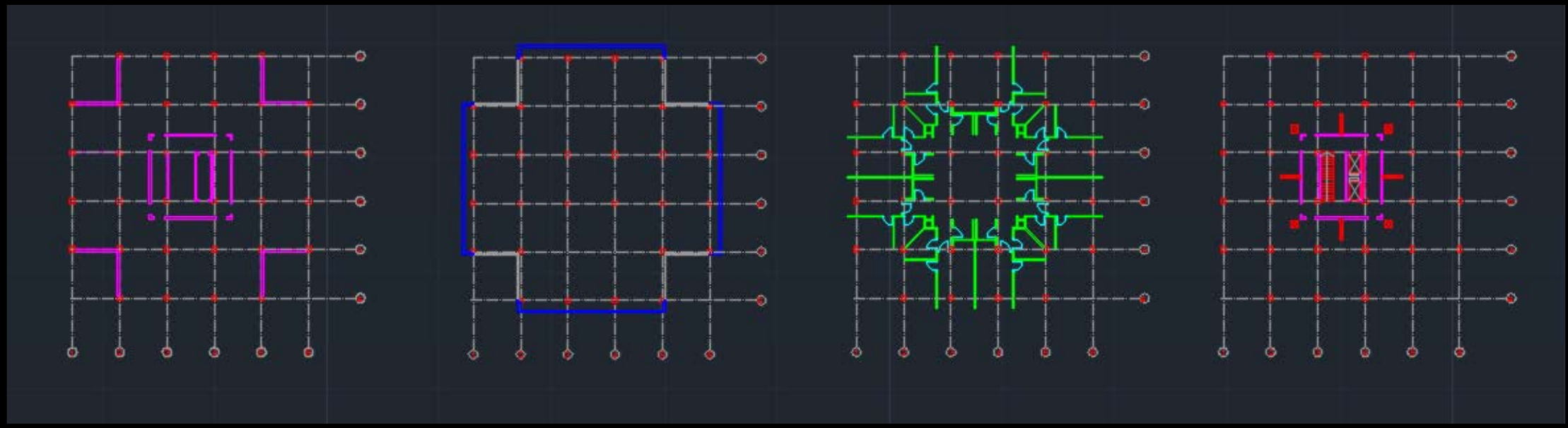
Block No. 2_ Condominum building: construction process in progress



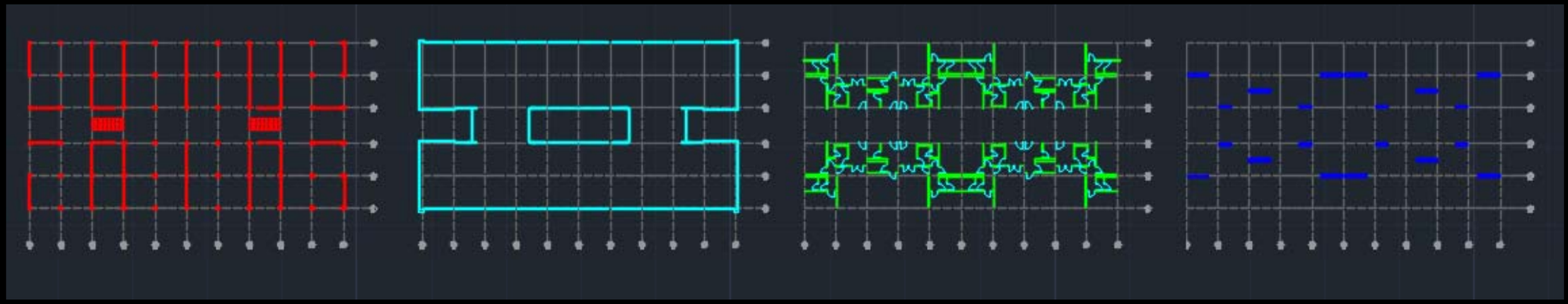
Parapet façade subsystem:(parapets, windows)



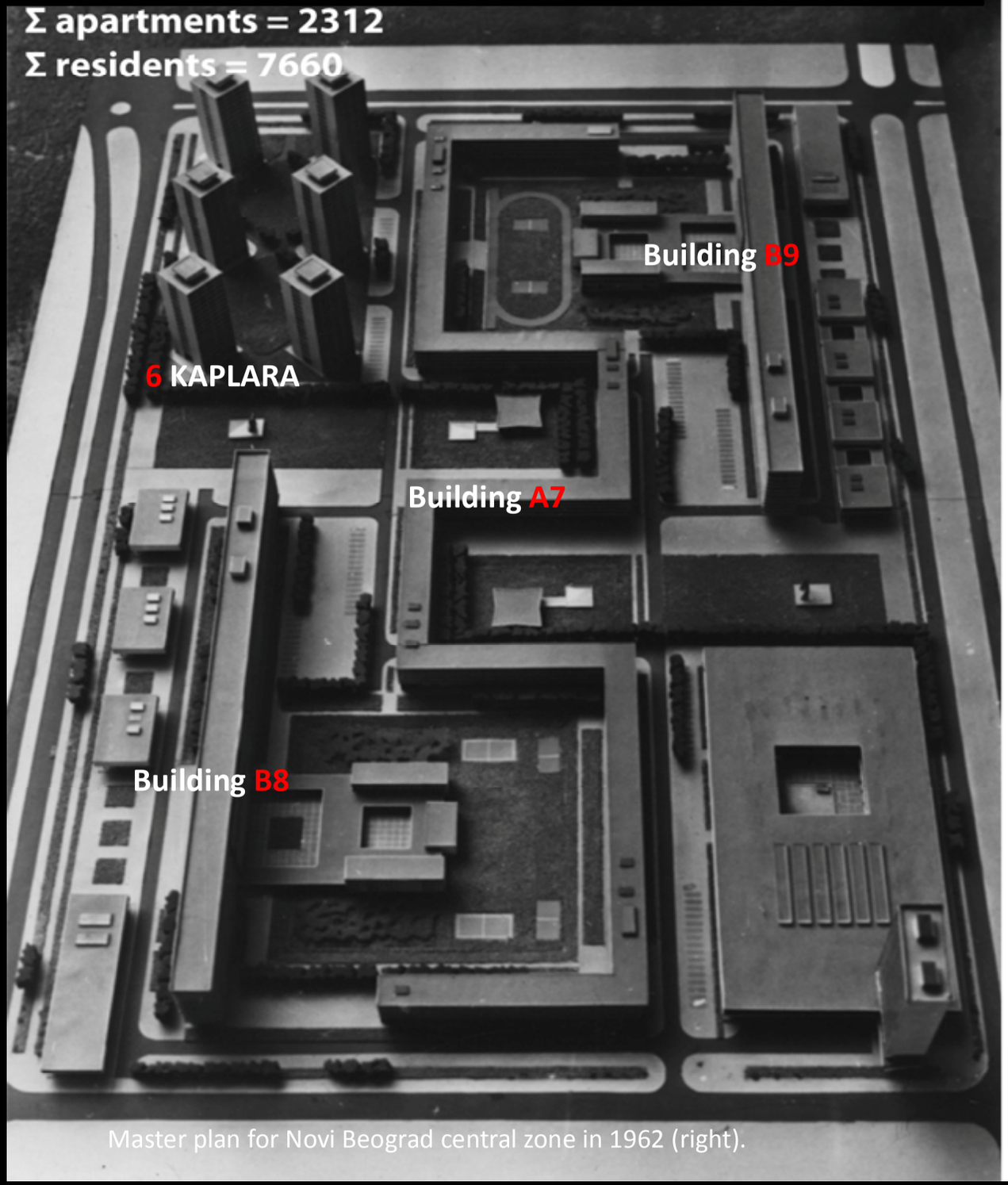
Building Model for tower and condominium building : typical floor plan



A building model decomposition into main functional and technical levels: load-bearing, façade, partitions and services.



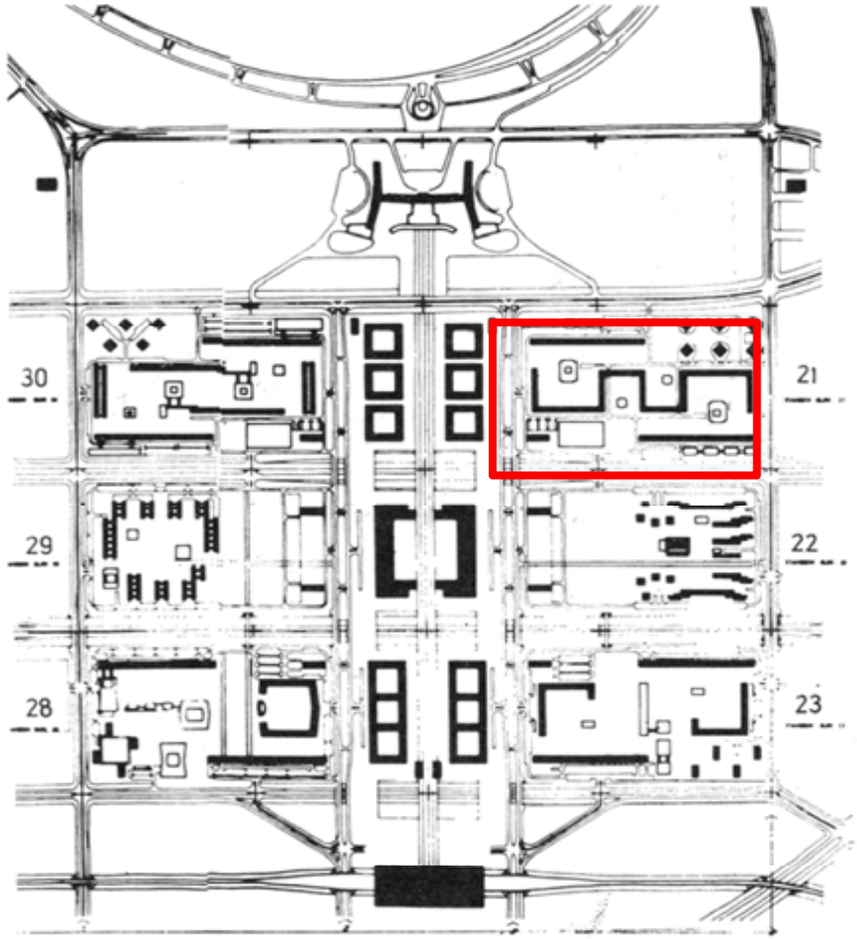
Appendix - Block No.21 : *Meander building*



Master plan for Novi Beograd central zone in 1962 (right).

Central zone of New Belgrade

- Representative => policy of competitions
- for government and army employees
- supervised by Communist party officials and Tito himself



Block No. 21 - Building A7 - MEANDER

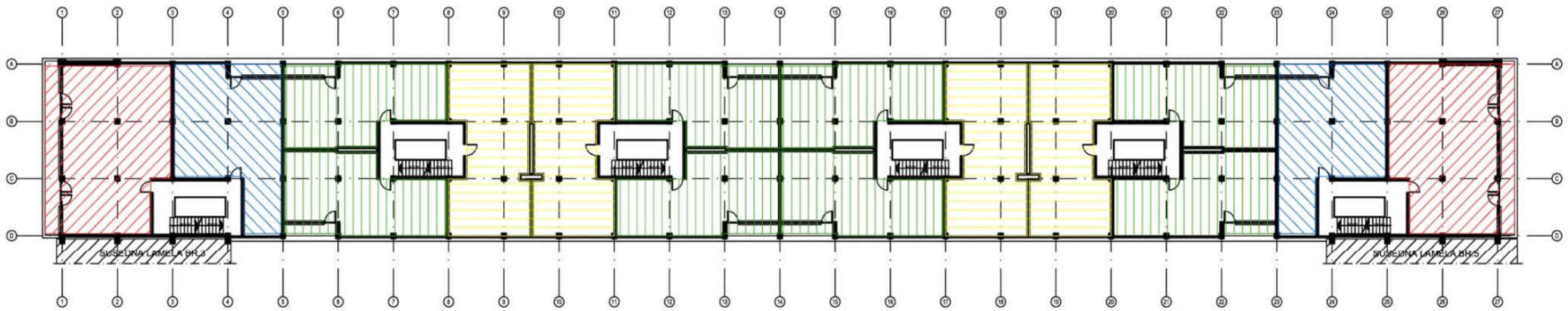


Figure : Typical floor plan and dwelling types

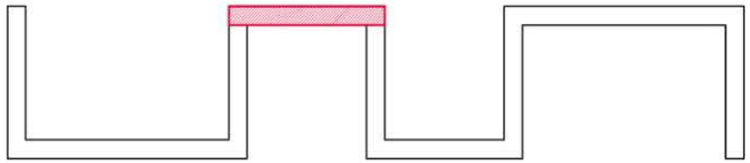
Dwelling 25

Dwelling 26

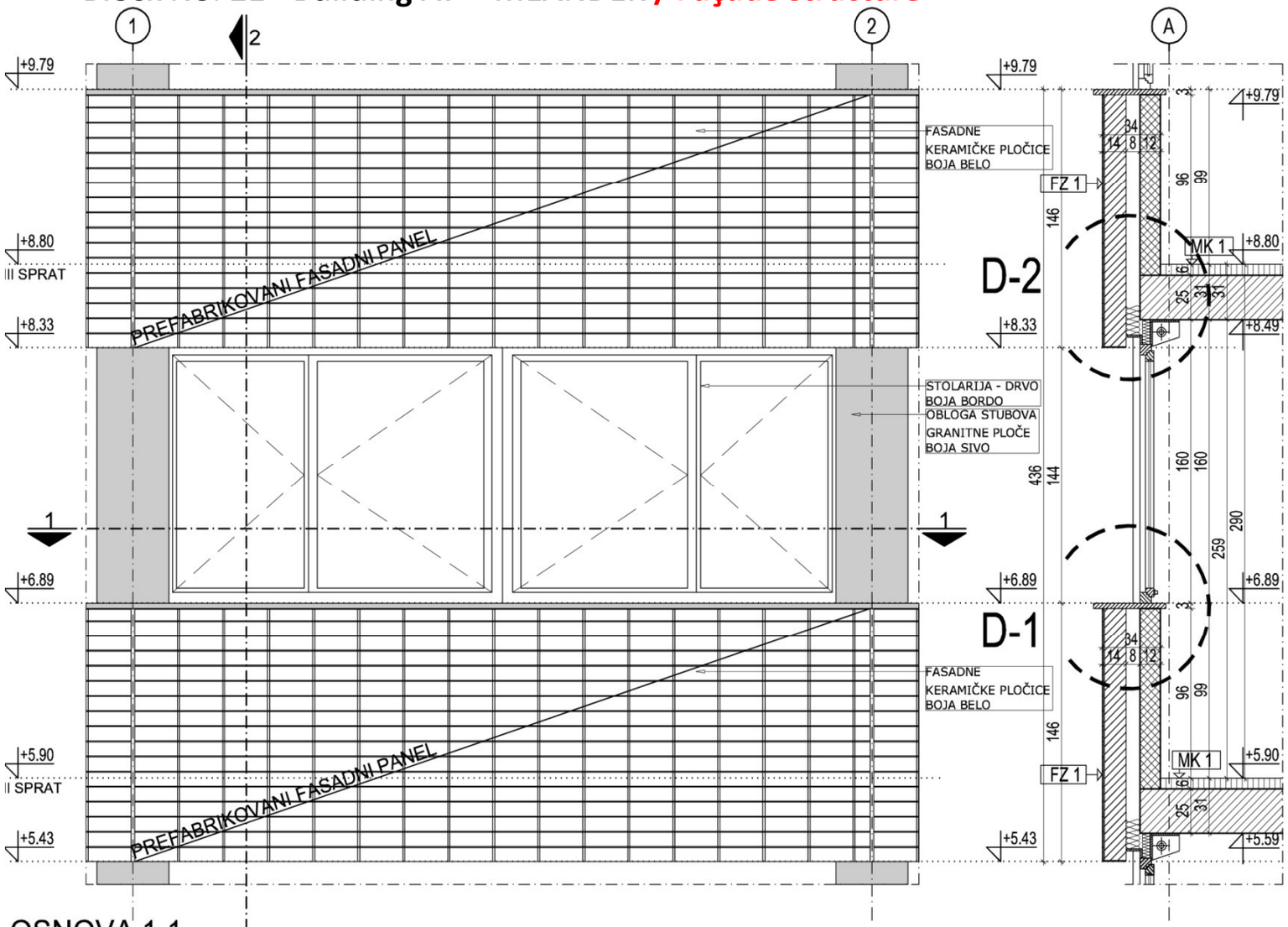
Dwelling 28

Dwelling 29

POSITION OF THE B. part No.4 IN RELATION WITH THE BUILDING



Block No. 21 - Building A7 – MEANDER / *Façade structure*



Block No. 21: Building B9 – Mixed system for the façade

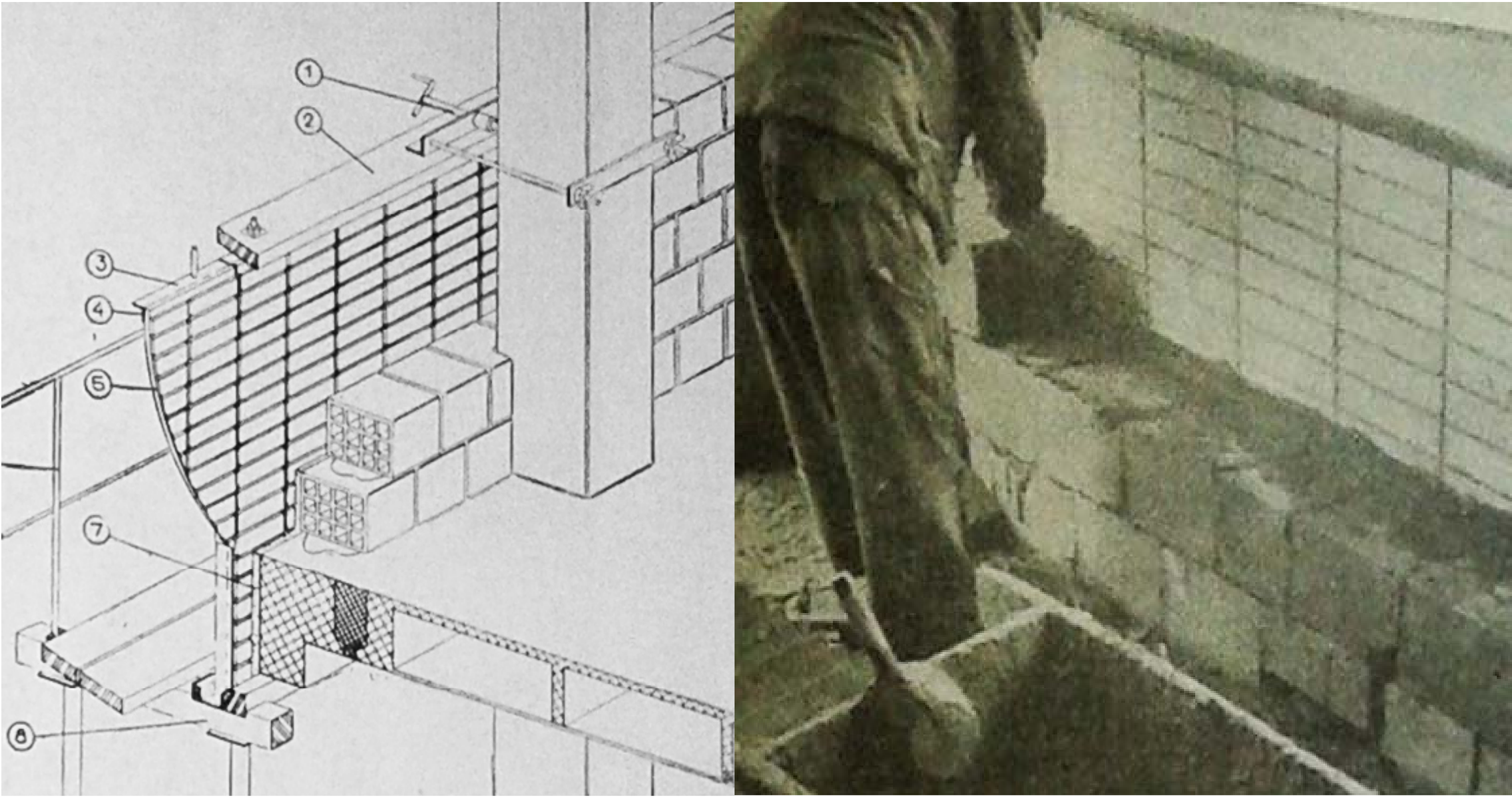
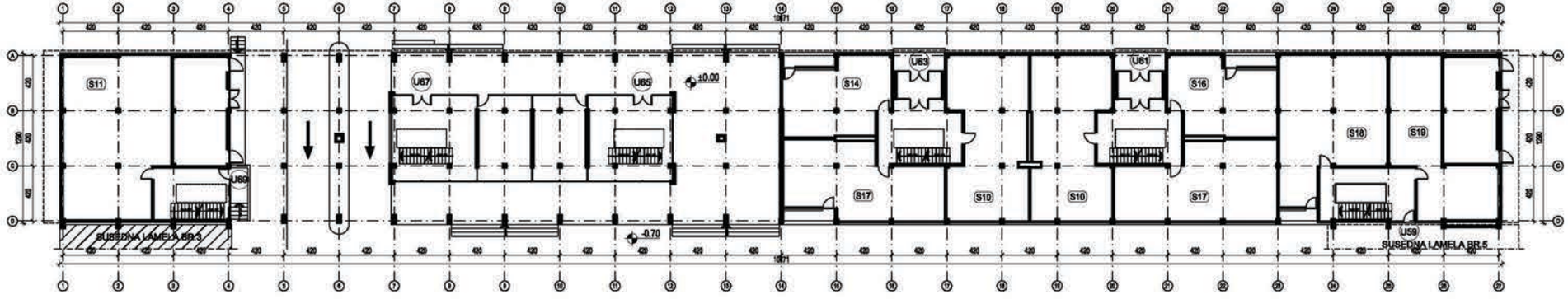
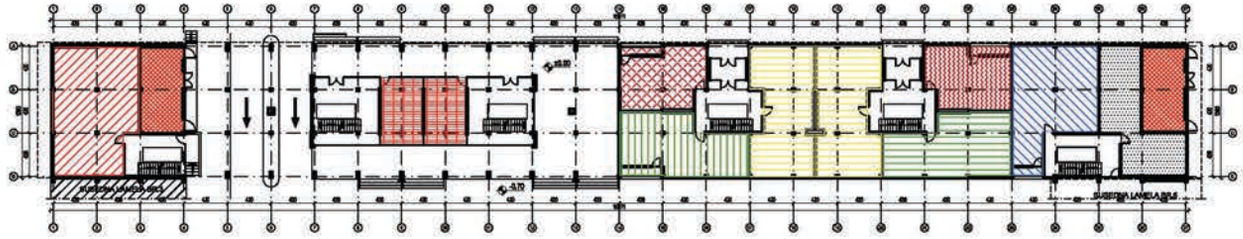


Figure: Combination of conventional and prefabricated systems in façade construction (Block No.21-Industrialized concrete parapet (6 cm + ceramic tiles), conventional brick parapet from the inside)

OSNOVA PRIZEMLJA R=1:325



OSNOVA PRIZEMLJA R=1:500 - ŠEMATSKI PRIKAZ STANOVA



NETO POVRŠINA OBJEKAT "MEANDAR" - LAMELA 4 - PRIZEMLJE				
	STAN - POZICIJA - NETO	P(m2)	KOM.	P(m2)
1.	STAN 10	67.32	2	134.64
2.	STAN 11	91.71	1	91.71
3.	STAN 14	45.86	1	45.86
4.	STAN 15	61.94	1	61.94
5.	STAN 16	46.30	1	46.30
6.	STAN 17	62.38	1	62.38
7.	STAN 18	77.83	1	77.83
8.	STAN 19	55.46	1	55.46
9.	TRAFO	32.37	2	64.74
10.	LOKALI	25.97	2	51.94
11.	STEPENIŠTE I	23.79	1	23.79
12.	STEPENIŠTE II	29.45	2	58.90
13.	STEPENIŠTE III	36.32	2	72.64
14.	STEPENIŠTE III	16.42	1	16.42
	U K U P N O			864.55
15.	TREM - ULAZ 61 i 63	8.19	2	16.38
16.	TREM - ULAZ 65 i 67	240.29	1	240.29
17.	PLATO KOD TRAFOA	16.19	1	16.19
	U K U P N O			256.48
	U K U P N O			1121.03

LEGENDA STANOVA PRIZEMLJE

- STAN 10
- STAN 11
- STAN 14
- STAN 15
- STAN 16
- STAN 17
- STAN 18
- STAN 19

POLOŽAJ LAMELE BR.4 U ODNOSU NA OBJEKAT "MEANDAR"

AGENCIJA ARHITEKT
SAMOSTALNA AGENCIJA ZA TEHNIČKO-EKONOMSKE USLUGE
Bul. Mihajla Pupina br.63
BEOGRAD
TEL. 063 345-355

INVESTITOR:

EV.BR.

ODG. PROJEKTANT: Petar Mišković d.i.a.
LICENCA BR. 300 6693 04

SARADNIK: Damir Česko d.i.a.

OBJEKAT: OBJEKAT "MEANDAR" LAMELA BR.4

LOKACIJA: Bul.Mihajla Pupina br.59-69 Opština Novi Beograd

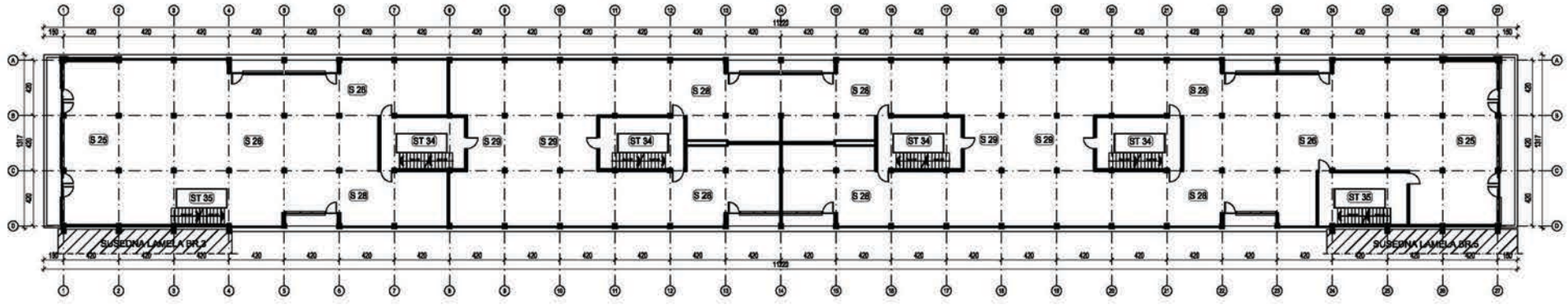
KAT.BR.PARCELE

PROJEKAT: STUDIJA IZVODLJIVOSTI ENERGET. EFIKASNOSTI

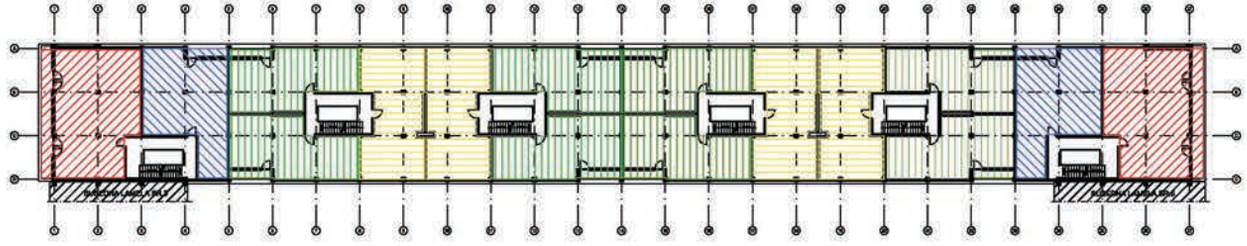
CRTEŽ: OSNOVA PRIZEMLJA

REVIZIJA	FAZA	DATUM	RAZMERA	LIST BR.
	A	MART.14	1:325	01

OSNOVA TIPSKE ETAŽE R=1:325



OSNOVA TIPSKE ETAŽE R=1:500 - ŠEMATSKI PRIKAZ STANOVA



NETO POVRŠINA
OBJEKAT "MEANDAR" - LAMELA 4 - TIPSKA ETAŽA

	POZICIJA - NETO	P(m2)	KOM.	P(m2)
1.	STAN 25	112.22	2	224.44
2.	STAN 26	80.23	2	160.46
3.	STAN 28	65.23	8	521.84
4.	STAN 29	70.89	4	283.56
5.	STEPENIŠTE 34	15.27	4	61.08
6.	STEPENIŠTE 35	15.37	2	30.74
	UKUPNO			1282.12

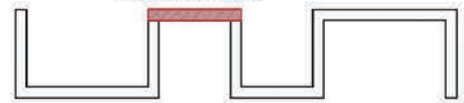
BRUTO POVRŠINA
OBJEKAT "MEANDAR" - LAMELA 4 - TIPSKA ETAŽA

	OBJEKAT - TIPSKA ETAŽA	P(m2)
	UKUPNO	1490.42

LEGENDA STANOVA TIPSKA ETAŽA

- STAN 25
- STAN 26
- STAN 28
- STAN 29

POLOŽAJ LAMELE BR.4 U ODNOSU NA OBJEKAT "MEANDAR"



AGENCIJA ARHITEKT
SAMOSTALNA AGENCIJA ZA TEHNIČKO-EKONOMSKE USLUGE
Bul. Mihajla Pupina br.63
BEOGRAD
TEL. 063 345-355

INVESTITOR:

EV.BR.

ODG.PROJEKTANT: Petar Mišković d.i.a.
LICENCA BR. 300 6693 04

SARADNIK: Damir Česko d.i.a.

SARADNIK

SARADNIK

SPOLJNI SARADNIK

OBJEKAT: OBJEKAT "MEANDAR" LAMELA BR.4

LOKACIJA: Bul.Mihajla Pupina br.59-69 Opština Novi Beograd

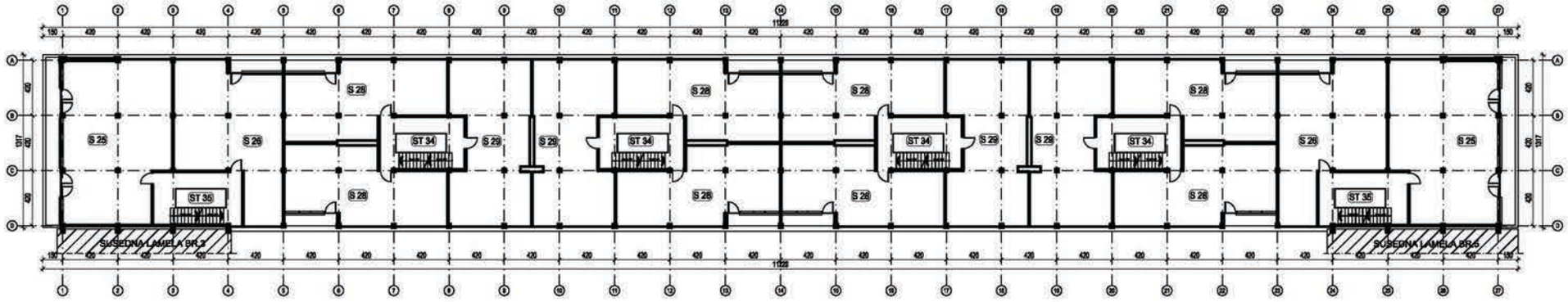
KAT.BR.PARCELE

PROJEKAT: STUDIJA IZVODLJIVOSTI ENERGET.EFIKASNOSTI

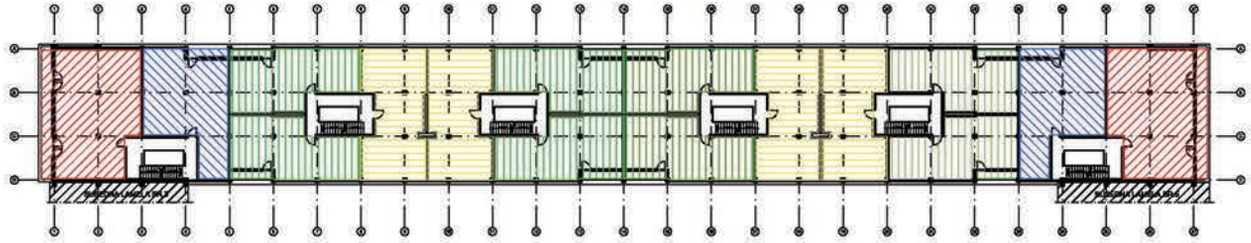
CRTEŽ: OSNOVA TIPSKE ETAŽE

REVIZIJA	FAZA	DATUM	RAZMERA	LIST BR.
	A	MAJ.14	1:325	02

OSNOVA TIPSKE ETAŽE R=1:325



OSNOVA TIPSKE ETAŽE R=1:500 - ŠEMATSKI PRIKAZ STANOVA



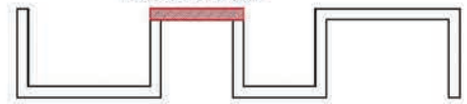
NETO POVRŠINA OBJEKAT "MEANDAR" - LAMELA 4 - TIPSKA ETAŽA				
	POZICIJA - NETO	P(m2)	KOM.	P(m2)
1.	STAN 25	112.22	2	224.44
2.	STAN 26	80.23	2	160.46
3.	STAN 28	65.23	8	521.84
4.	STAN 29	70.89	4	283.56
5.	STEPENIŠTE 34	15.27	4	61.08
6.	STEPENIŠTE 35	15.37	2	30.74
	UKUPNO			1282.12

BRUTO POVRŠINA OBJEKAT "MEANDAR" - LAMELA 4 - TIPSKA ETAŽA		
	OBJEKAT - TIPSKA ETAŽA	P(m2)
	UKUPNO	1490.42

LEGENDA STANOVA TIPSKA ETAŽA

- STAN 25
- STAN 26
- STAN 28
- STAN 29

POLOŽAJ LAMELE BR.4 U ODNOSU NA OBJEKAT "MEANDAR"



AGENCIJA ARHITEKT
AGENCIJA ARHITEKT SAMOSTALNA AGENCIJA ZA TEHNIČKO-EKONOMSKE USLUGE
Bul. Mihajla Pupina br.63
BEOGRAD
TEL. 063 345-355

INVESTITOR:

EV.BR.

ODG.PROJEKTANT: Petar Mišković d.i.a.
LICENCA BR. 300 6693 04

SARADNIK: Damir Česko d.i.a.

SARADNIK

SARADNIK

SPOLJNI SARADNIK

OBJEKAT: OBJEKAT "MEANDAR" LAMELA BR.4

LOKACIJA: Bul.Mihajla Pupina br.59-69 Opština Novi Beograd

KAT.BR.PARCELE

PROJEKAT: STUDIJA IZVODLJIVOSTI ENERGET.EFIKASNOSTI

CRTEŽ: OSNOVA TIPSKE ETAŽE

REVIZIJA	FAZA	DATUM	RAZMERA	LIST BR.
	A	MART.14	1:325	02

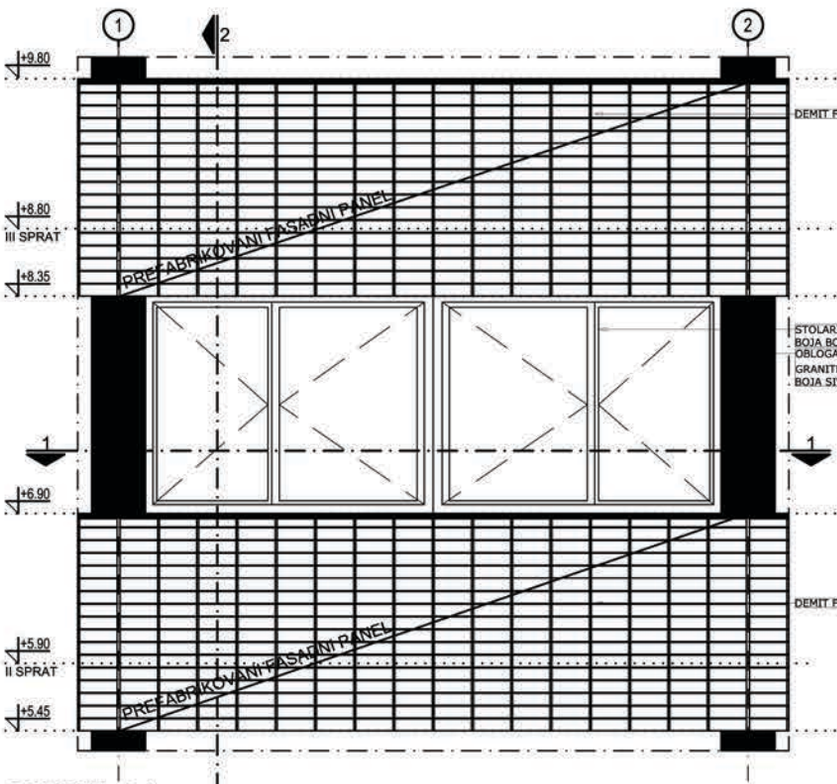
INVESTITOR		ŠEMA SPOLJNE STOLARIJE
PROJEKAT I MESTO	BLOK 21 - OBJEKAT "MEANDAR" BUL.MIHAJLA PUPINA BR.59-69	

ARHITEKT AGENCIJA

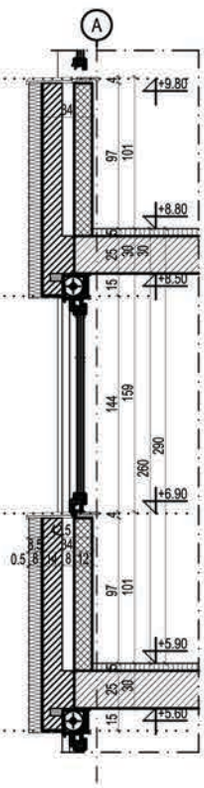
ČETVOROKRILNI PROZOR DIM.390x160cm

1

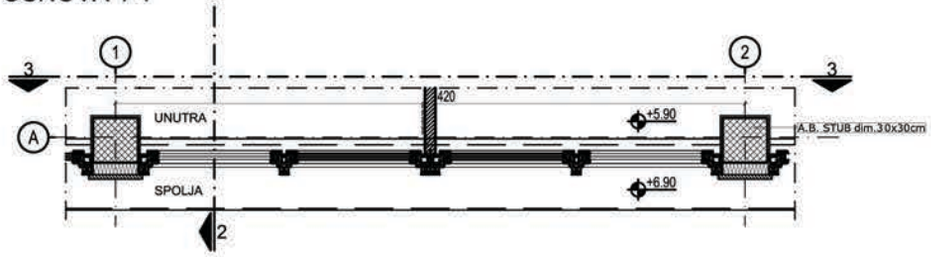
IZGLED 3-3



PRESEK 2-2



OSNOVA 1-1



TEHNIČKI OPIS:

Serija M 11000 ALUTHERM PLUS sa termo-prekidom.Krilo širine 70mm na 62mm širokom štoku
Zvučna izolacija(52dB) sa tri niza specijalnih guma(EPDM) - sistem ALUSEAL
Staklo troslojno 4+12+4+12+4=36mm ; nisko emisiono(punjeno argonom.AL.roletna.
Sve otvarajuće pozicije opremiti Rolo komarnicima.
Sa spoljne strane postaviti alu. solbank i pod prozorske daske je od PVC (unutra).
Spolja uložine oko bravarije obraditi ,a iznutra opšiti alu. lajsnama.
Al.profile plastificirati u dve boje: RAL 3004 - BORDO BOJA - SPOLJA i RAL 9016 - BELA BOJA - UNUTRA.

OKOVI:

OKRETNO NAGIBNI OKOV STUBLINA ILI SLIČNO.
RUČICE POSTAVITI NA 160cm OD GOTOVOG PODA.

POZICIJA		
PRIZ. - 4.SPRAT		
POVRŠINA	KOM.	UKUPNO POVRŠ.
6.24m2	149	929.76m2

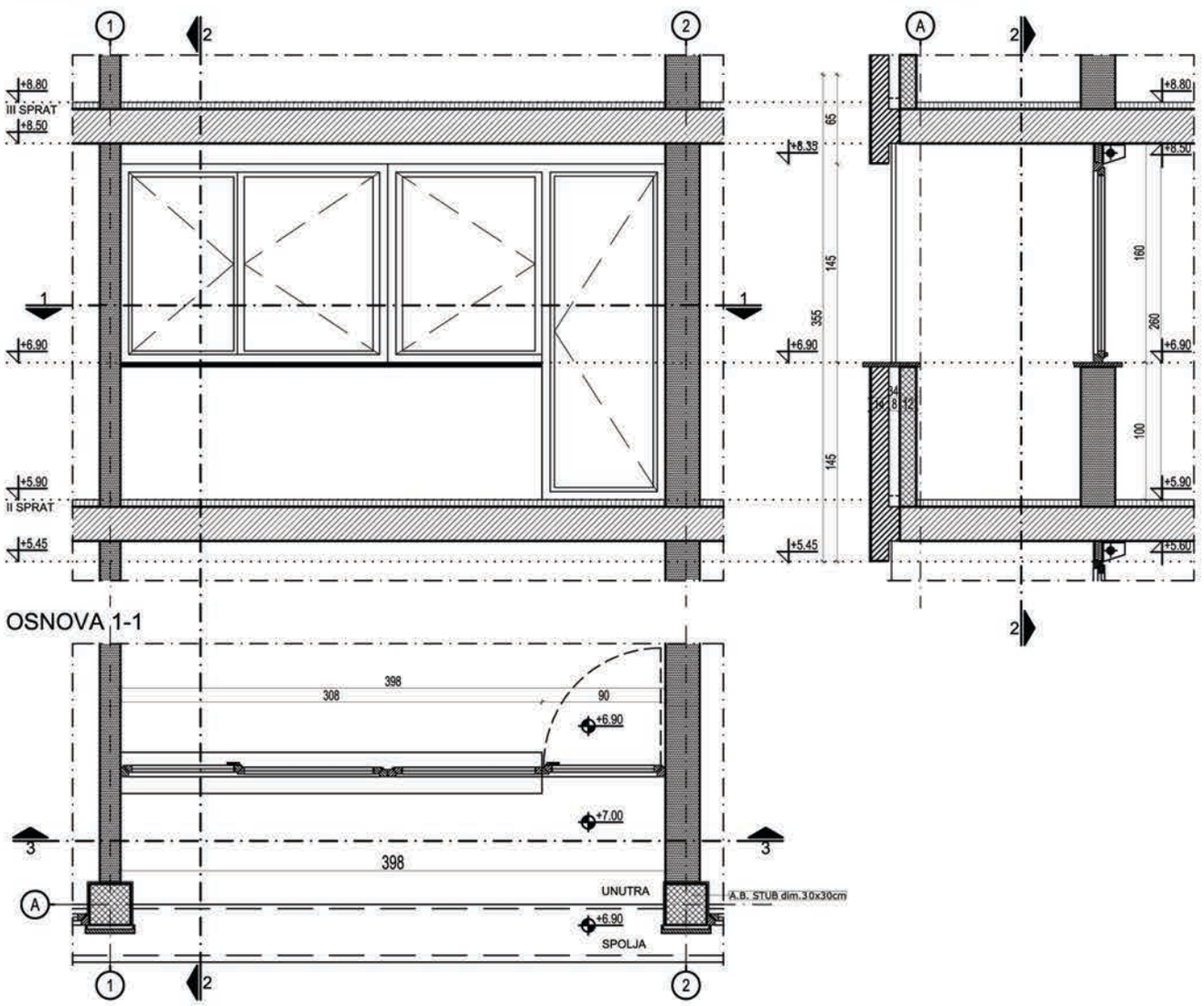
*NAPOMENA:
1.HORIZONTALNE I VERTIKALNE DETALJE SPOJA FASADNE AL.BRAVARIJE SA PODOM, ZIDOVIMA I PLAFONOM DEFINISATI I RAZREŠITI SA PROJEKTANTOM.
2.SVE POTREBNE MERE UZETI NA LICU MESTA.

R 1:50
LIST BROJ: 01

INVESTITOR		ŠEMA SPOLJNE STOLARIJE
PROJEKAT I MESTO	BLOK 21 - OBJEKAT "MEANDAR" BUL.MIHAJLA PUPINA BR.59-69	

TROKRILNI PROZOR + BALKONSKA VRATA - DIM. 390x160-260cm

3



TEHNIČKI OPIS:

Serija M 11000 ALUTHERM PLUS sa termo-prekidom.Krilo širine 70mm na 62mm širokom štoku
Zvučna izolacija(52dB) sa tri niza specijalnih guma(EPDM) - sistem ALUSEAL
Staklo troslojno 4+12+4+12+4=36mm ; nisko emisiono(punjeno argonom.AL.roletna.
Sve otvarajuće pozicije opremiti Rolo komarnicima.
Sa spoljne strane postaviti alu. solbank i pod prozorske daske je od PVC (unutra).
Spolja uložine oko bravarije obraditi ,a iznutra opšiti alu. lajsnama.
Al.profile plastificirati u dve boje: RAL 3004 - BORDO BOJA - SPOLJA i RAL 9016 - BELA BOJA - UNUTRA.

OKOVI:

OKRETNO NAGIBNI OKOV STUBLINA ILI SLIČNO.
RUČICE POSTAVITI NA 160cm OD GOTOVOG PODA.

POZICIJA		
PRIZ. - 4.SPRAT		
POVRŠINA	KOM.	UKUPNO POVRŠ.
7.60m2	44	334.40m2

*NAPOMENA:
1.HORIZONTALNE I VERTIKALNE DETALJE SPOJA FASADNE AL.BRAVARIJE SA PODOM, ZIDOVIMA I PLAFONOM DEFINISATI I RAZREŠITI SA PROJEKTANTOM.
2.SVE POTREBNE MERE UZETI NA LICU MESTA.

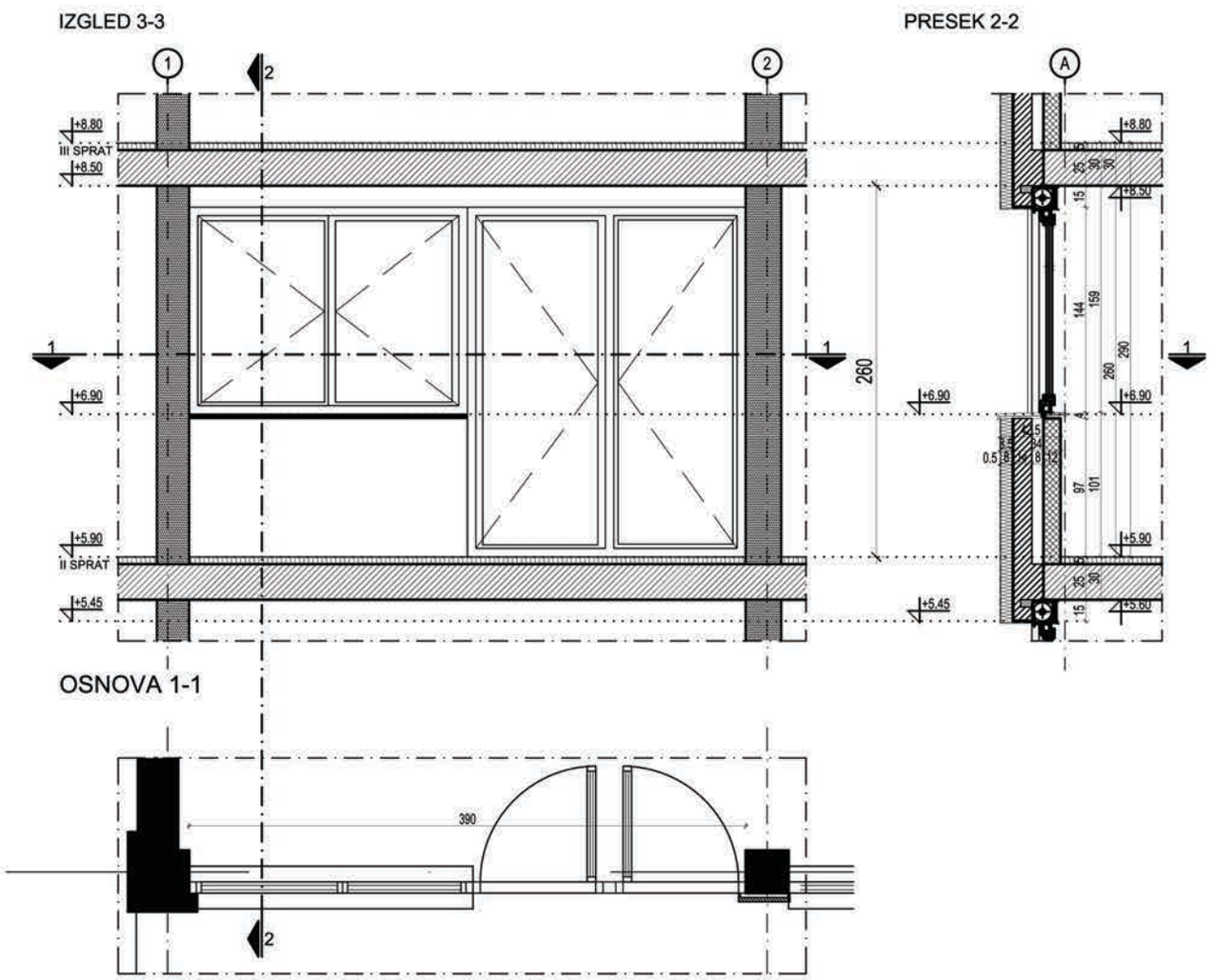
R 1:50
LIST BROJ: 03

INVESTITOR		ŠEMA SPOLJNE STOLARIJE
PROJEKAT I MESTO	BLOK 21 - OBJEKAT "MEANDAR" BUL.MIHAJLA PUPINA BR.59-69	

ARHITEKT AGENCIJA

DVOKRILNI PROZOR + BALKONSKA VRATA - DIM. 390x160-260cm

4



TEHNIČKI OPIS:

Serija M 11000 ALUTHERM PLUS sa termo-prekidom.Krilo širine 70mm na 62mm širokom štoku
Zvučna izolacija(52dB) sa tri niza specijalnih guma(EPDM) - sistem ALUSEAL
Staklo troslojno 4+12+4+12+4=36mm ; nisko emisiono(punjeno argonom.AL.roletna.
Sve otvarajuće pozicije opremiti Rolo komarnicima.
Sa spoljne strane postaviti alu. solbank i pod prozorske daske je od PVC (unutra).
Spolja uložine oko bravarije obraditi ,a iznutra opšiti alu. lajsnama.
Al.profile plastificirati u dve boje: RAL 3004 - BORDO BOJA - SPOLJA i RAL 9016 - BELA BOJA - UNUTRA.

OKOVI:

OKRETNO NAGIBNI OKOV STUBLINA ILI SLIČNO.
RUČICE POSTAVITI NA 160cm OD GOTOVOG PODA.

POZICIJA		
1.SPRAT - 4.SPRAT		
POVRŠINA	KOM.	UKUPNO POVRŠ.
8.19m2	16	131.04m2

*NAPOMENA:
1.HORIZONTALNE I VERTIKALNE DETALJE SPOJA FASADNE AL.BRAVARIJE SA PODOM, ZIDOVIMA I PLAFONOM DEFINISATI I RAZREŠITI SA PROJEKTANTOM.
2.SVE POTREBNE MERE UZETI NA LICU MESTA.

R 1:50
LIST BROJ: 04

INVESTITOR		ŠEMA SPOLJNE STOLARIJE
PROJEKAT I MESTO	BLOK 21 - OBJEKAT "MEANDAR" BUL.MIHAJLA PUPINA BR.59-69	

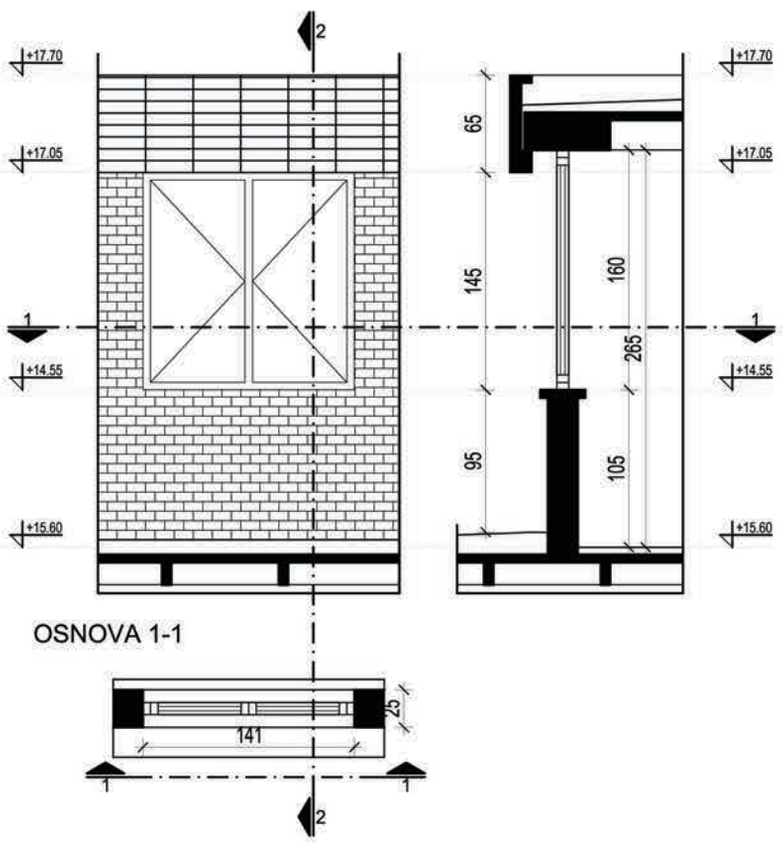
ARHITEKT AGENCIJA

DVOKRILNI PROZOR - DIM.140x160cm

5

IZGLED 3-3

PRESEK 2-2



OSNOVA 1-1

TEHNIČKI OPIS:

Serija M 11000 ALUTHERM PLUS sa termo-prekidom.Krilo širine 70mm na 62mm širokom štoku
Zvučna izolacija(52dB) sa tri niza specijalnih guma(EPDM) - sistem ALUSEAL
Staklo troslojno 4+12+4+12+4=36mm ; nisko emisiono(punjeno argonom.AL.roletna.
Sve otvarajuće pozicije opremiti Rolo komarnicima.
Sa spoljne strane postaviti alu. solbank i pod prozorske daske je od PVC (unutra).
Spolja uložine oko bravarije obraditi ,a iznutra opšiti alu. lajsnama.
Al.profile plastificirati u dve boje: RAL 3004 - BORDO BOJA - SPOLJA i RAL 9016 - BELA BOJA - UNUTRA.

OKOVI:

OKRETNO NAGIBNI OKOV STUBLINA ILI SLIČNO.
RUČICE POSTAVITI NA 160cm OD GOTOVOG PODA.

POZICIJA		
POTKROVLJE		
POVRŠINA	KOM.	UKUPNO POVRŠ.
2.24m2	16	35.84m2

*NAPOMENA:
1.HORIZONTALNE I VERTIKALNE DETALJE SPOJA FASADNE AL.BRAVARIJE SA PODOM, ZIDOVIMA I PLAFONOM DEFINISATI I RAZREŠITI SA PROJEKTANTOM.
2.SVE POTREBNE MERE UZETI NA LICU MESTA.

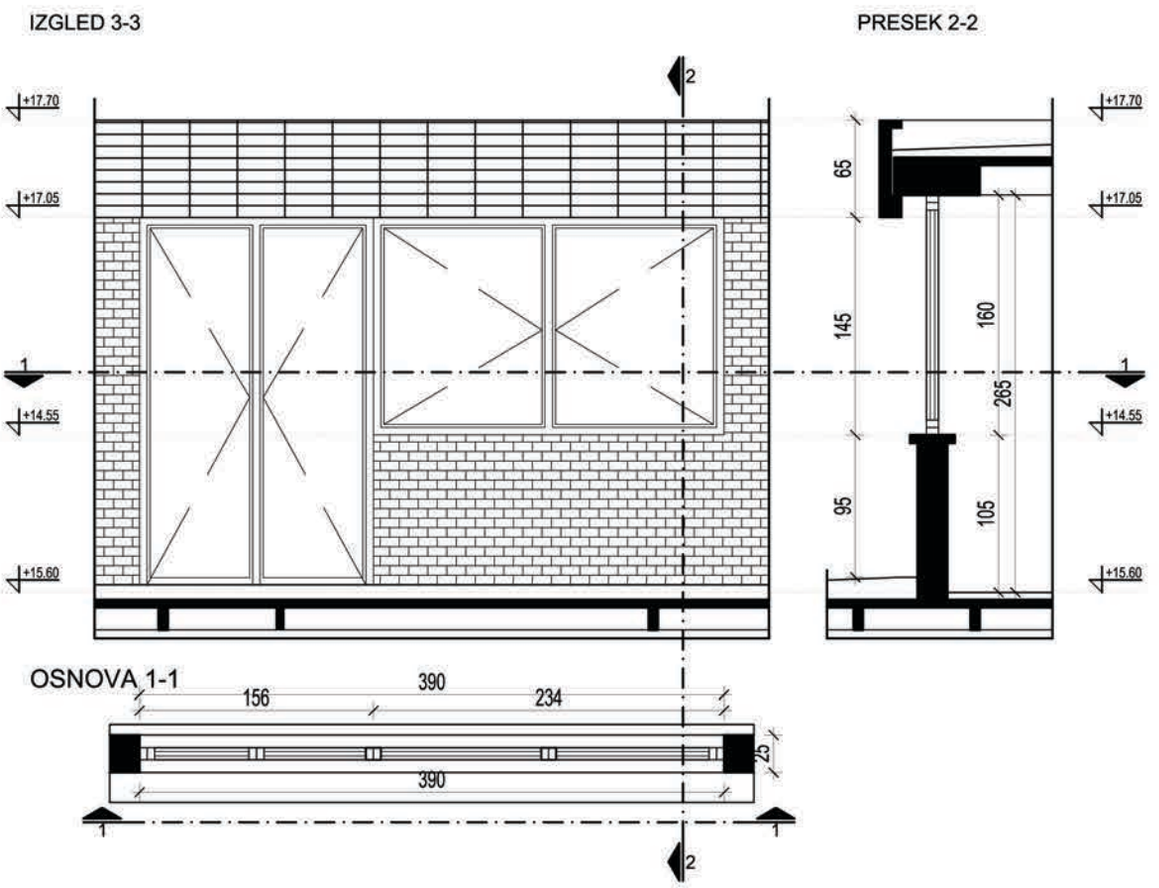
R 1:50
LIST BROJ: 05

INVESTITOR		ŠEMA SPOLJNE STOLARIJE
PROJEKAT I MESTO	BLOK 21 - OBJEKAT "MEANDAR" BUL.MIHAJLA PUPINA BR.59-69	

ARHITEKT AGENCIJA

DVOKRILNI PROZOR + BALK. VRATA - DIM.234x160cm + 156x260cm

6



TEHNIČKI OPIS:

Serija M 11000 ALUTHERM PLUS sa termo-prekidom.Krilo širine 70mm na 62mm širokom štoku
Zvučna izolacija(52dB) sa tri niza specijalnih guma(EPDM) - sistem ALUSEAL
Staklo troslojno 4+12+4+12+4=36mm ; nisko emisiono(punjeno argonom.AL.roletna.
Sve otvarajuće pozicije opremiti Rolo komarnicima.
Sa spoljne strane postaviti alu. solbank i pod prozorske daske je od PVC (unutra).
Spolja uložine oko bravarije obraditi ,a iznutra opšiti alu. lajsnama.
Al.profile plastificirati u dve boje: RAL 3004 - BORDO BOJA - SPOLJA i RAL 9016 - BELA BOJA - UNUTRA.

OKOVI:

OKRETNO NAGIBNI OKOV STUBLINA ILI SLIČNO.
RUČICE POSTAVITI NA 160cm OD GOTOVOG PODA.

POZICIJA		
POTKROVLJE		
POVRŠINA	KOM.	UKUPNO POVRŠ.
7.80m2	16	124.80m2

*NAPOMENA:
1.HORIZONTALNE I VERTIKALNE DETALJE SPOJA FASADNE AL.BRAVARIJE SA PODOM, ZIDOVIMA I PLAFONOM DEFINISATI I RAZREŠITI SA PROJEKTANTOM.
2.SVE POTREBNE MERE UZETI NA LICU MESTA.

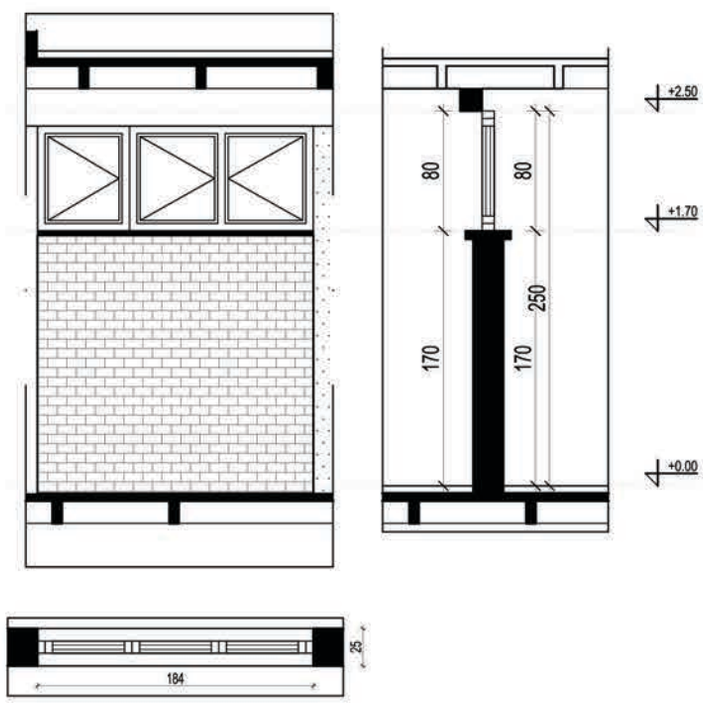
R 1:50
LIST BROJ: 06

INVESTITOR		ŠEMA SPOLJNE STOLARIJE
PROJEKAT I MESTO	BLOK 21 - OBJEKAT "MEANDAR" BUL.MIHAJLA PUPINA BR.59-69	

ARHITEKT AGENCIJA

TROKRILNI PROZOR - DIM.184x80cm

10



TEHNIČKI OPIS:
Serija M 11000 ALUTHERM PLUS sa termo-prekidom.Krilo širine 70mm na 62mm širokom štoku
Zvučna izolacija(52dB) sa tri niza specijalnih guma(EPDM) - sistem ALUSEAL
Staklo troslojno 4+12+4+12+4=36mm ; nisko emisiono(punjeno argonom.AL.roletna.
Sve otvarajuće pozicije opremiti Rolo komarnicima.
Sa spoljne strane postaviti alu. solbank i pod prozorske daske je od PVC (unutra).
Spolja uložine oko bravarije obraditi ,a iznutra opšiti alu. lajsnama.
Al.profile plastificirati u dve boje: RAL 3004 - BORDO BOJA - SPOLJA i RAL 9016 - BELA BOJA - UNUTRA.

OKOVI:
OKRETNO NAGIBNI OKOV STUBLINA ILI SLIČNO.
RUČICE POSTAVITI NA 160cm OD GOTOVOG PODA.

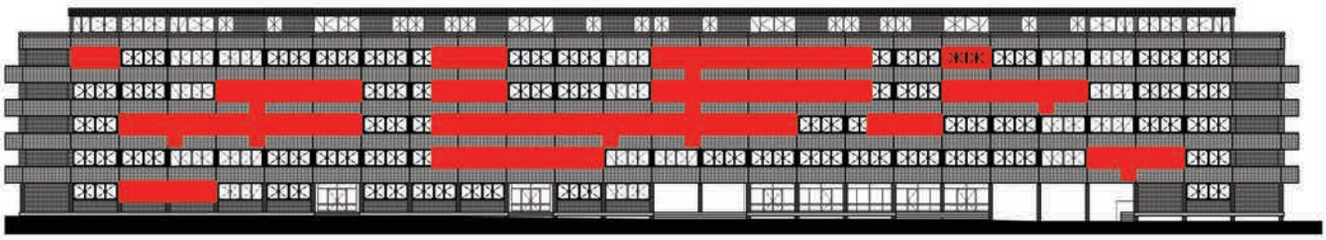
POZICIJA		
POTKROVLJE		
POVRŠINA	KOM.	UKUPNO POVRŠ.
1.47m2	1	1.47m2

*NAPOMENA:
1.HORIZONTALNE I VERTIKALNE DETALJE SPOJA FASADNE AL.BRAVARIJE SA PODOM, ZIDOVIMA I PLAFONOM DEFINISATI I RAZREŠITI SA PROJEKTANTOM.
2.SVE POTREBNE MERE UZETI NA LICU MESTA.

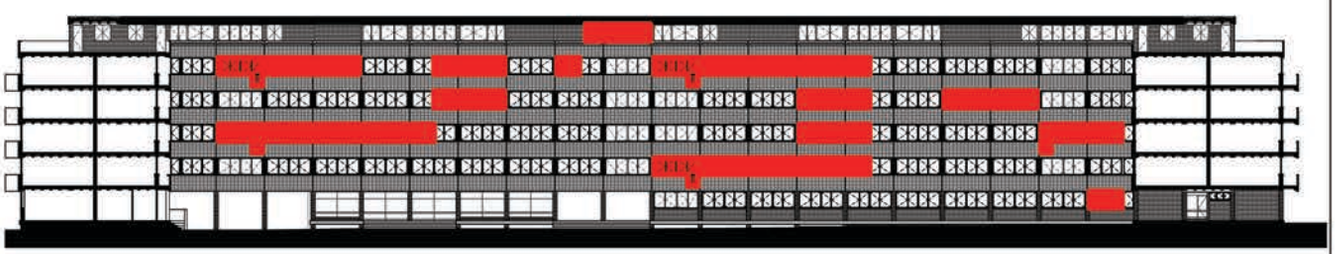
R 1:50
LIST BROJ:
10

STATISTIKA ZAMENJENIH POZICIJA STOLARIJE

SEVEROISTOČNA FASADA



JUGOZAPADNA FASADA



SEVEROZAPADNA FASADA

JUGOISTOČNA FASADA

STATISTIKA:

TOKOM GODINA POVRŠINA STARIH PROZORA KOJI SU ZAMENJENI NOVIM PROZORIMA IZNOSI 404.10m2 OD UKUPNE POVRŠINE OD 1458.97m2. PROCENAT ZAMENJENIH PROZORA IZNOSI 27.69%.

LEGENDA:

POZICIJE ZAMENJENIH PROZORA

AGENCIJA ARHITEKT

AGENCIJA ARHITEKT
SAMOSTALNA AGENCIJA ZA TEHNIČKO-EKONOMSKE USLUGE
Bul. Mihajla Pupina br.63
BEOGRAD
TEL. 063 345-355

ODG.PROJEKTANT: Petar Mišković d.i.a.
LICENCA BR. 300 6693 04

SARADNIK: Damir Česko d.i.a.

SARADNIK

SARADNIK

SPOLJNI SARADNIK

INVESTITOR:

EV.BR.

OBJEKAT: OBJEKAT "MEANDAR" LAMELA BR.4

LOKACIJA: Bul.Mihajla Pupina br.59-69 Opština Novi Beograd

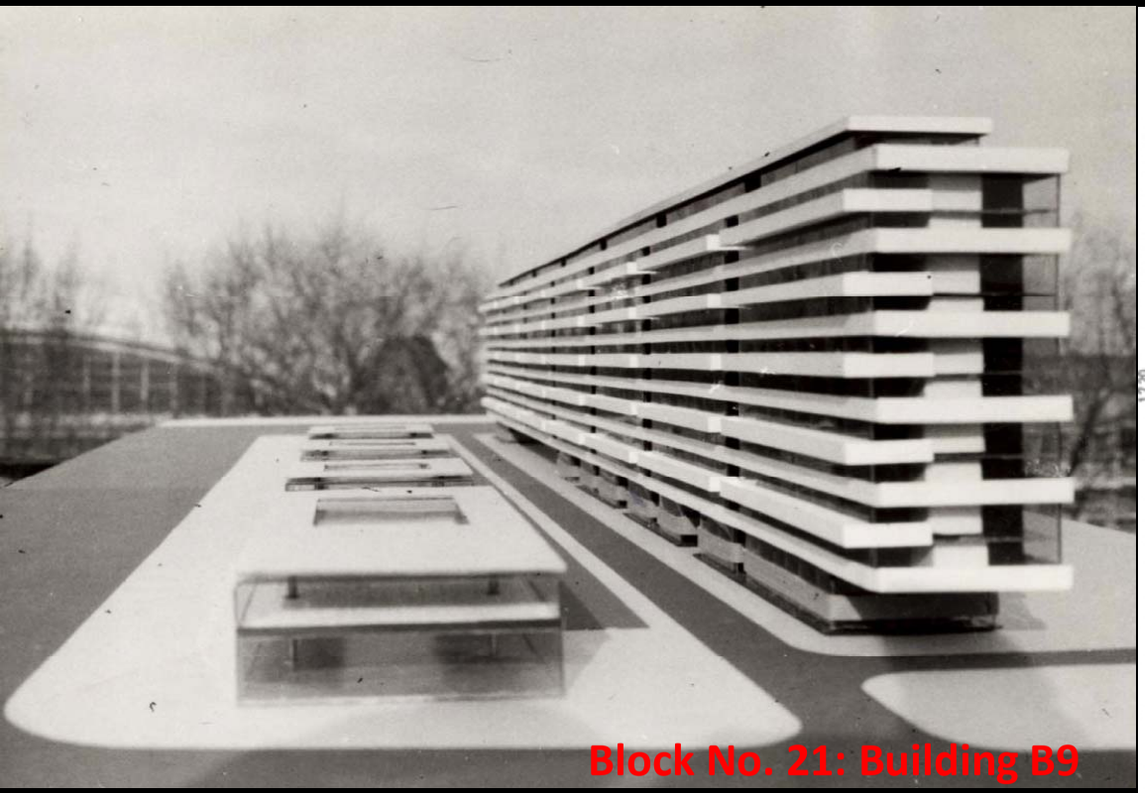
KAT.BR.PARCELE

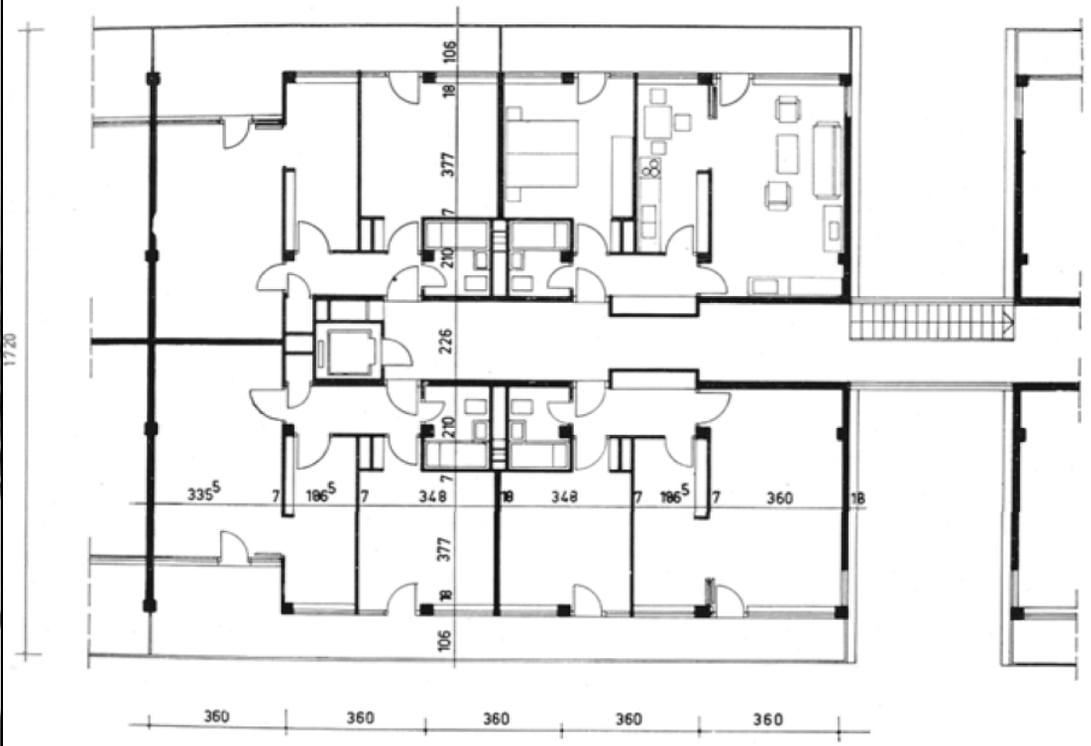
PROJEKAT: STUDIJA IZVODLJIVOSTI ENERGET.EFIKASNOSTI

CRTEŽ: PROCENAT ZAMENJENIH PROZORA

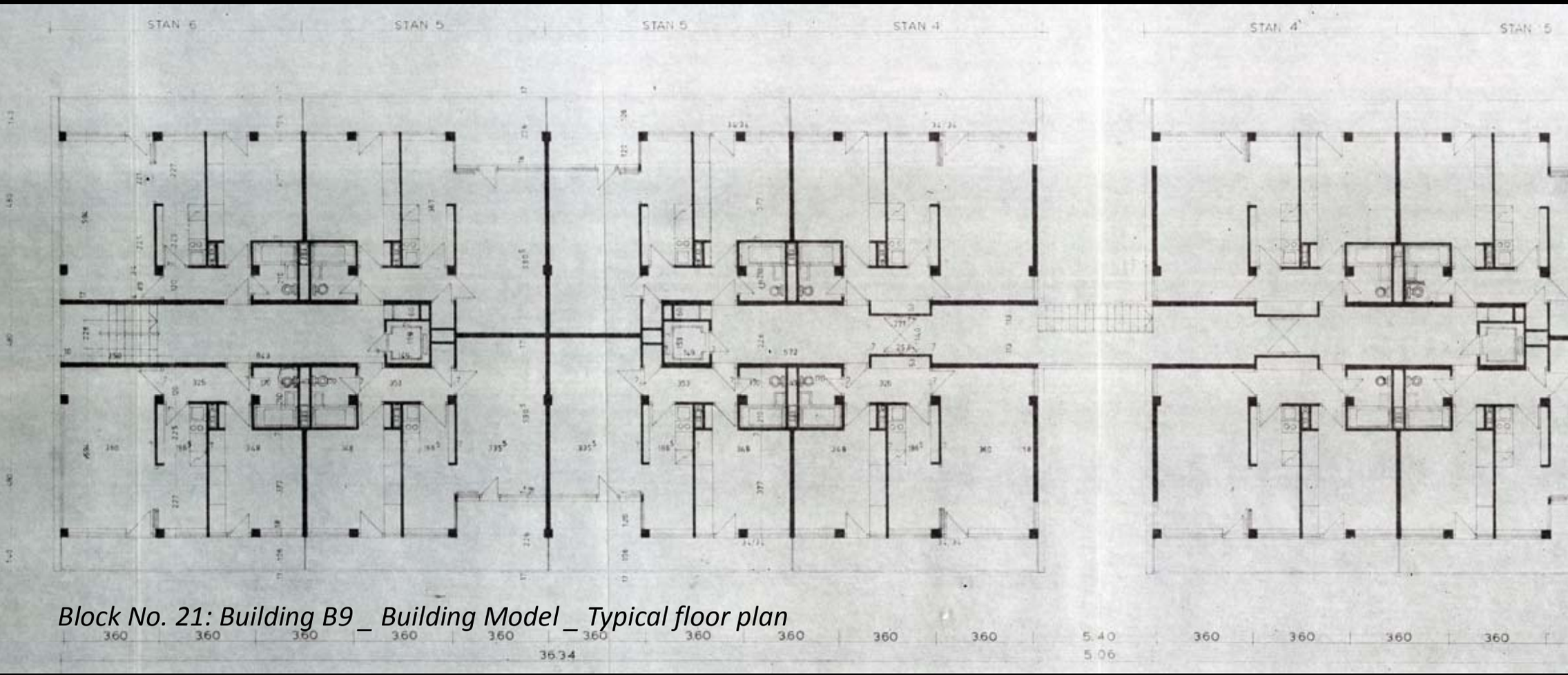
REVIZIJA	FAZA	DATUM	RAZMERA	LIST BR.
	A	MAJ.14	1:325	01

APPENDIX - Block No. 21: Building B9



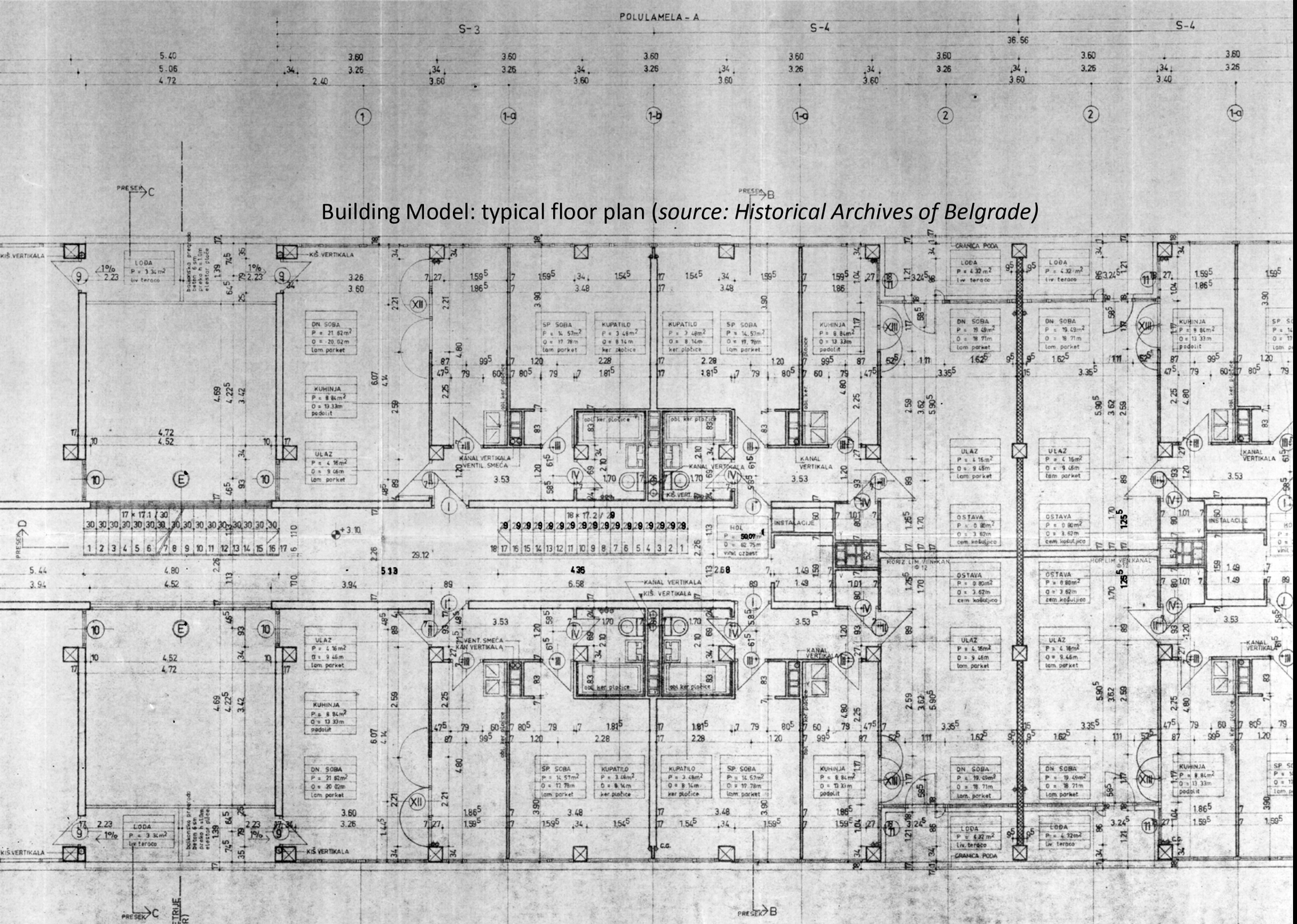


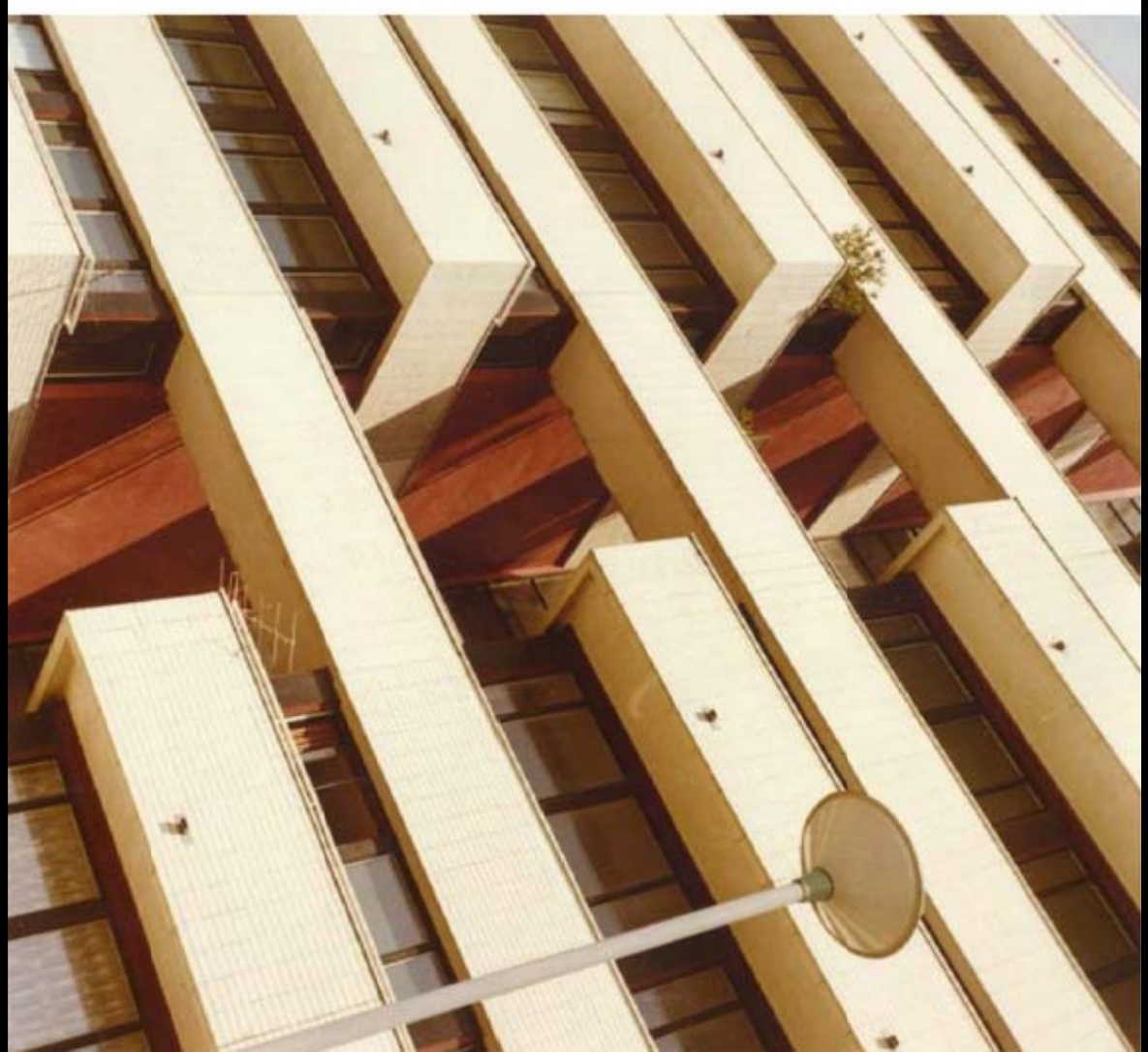
Building B9 - 1st floor, long 280 m
Čanak, Lenarčič, Mitić, Petrović
Institut IMS
10 storeys x 50 apartments / story
(~175 residents / story)
500 apartments | 1750 residents
618 apartments were built

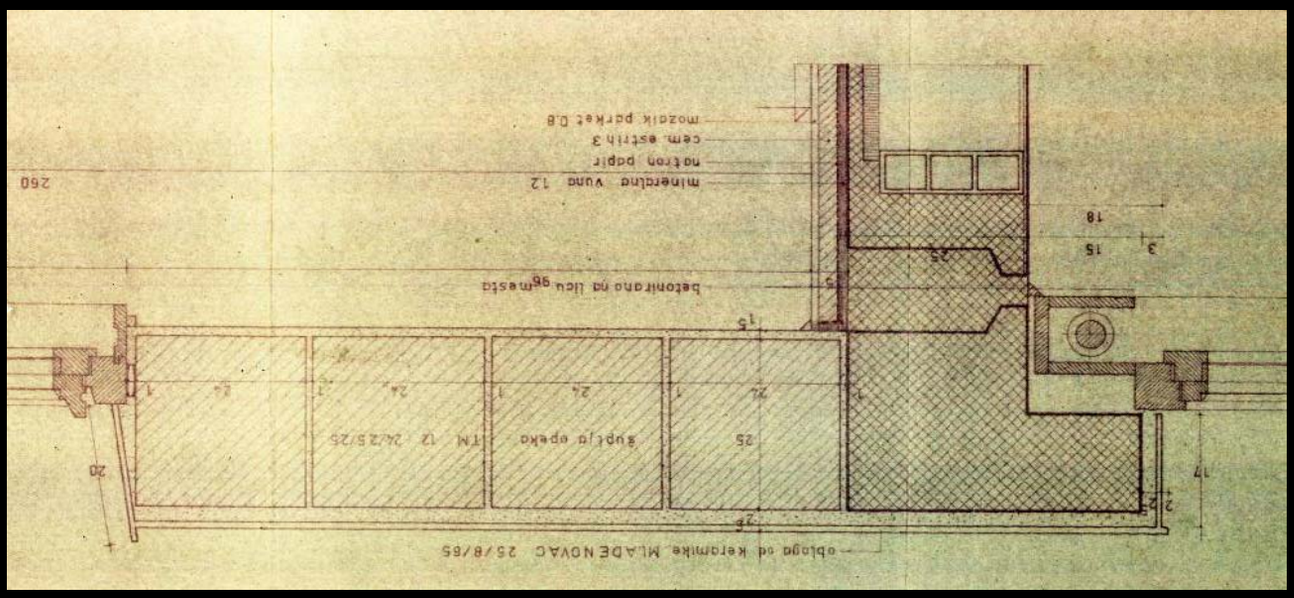


Block No. 21: Building B9 _ Building Model _ Typical floor plan

Building Model: typical floor plan (*source: Historical Archives of Belgrade)*







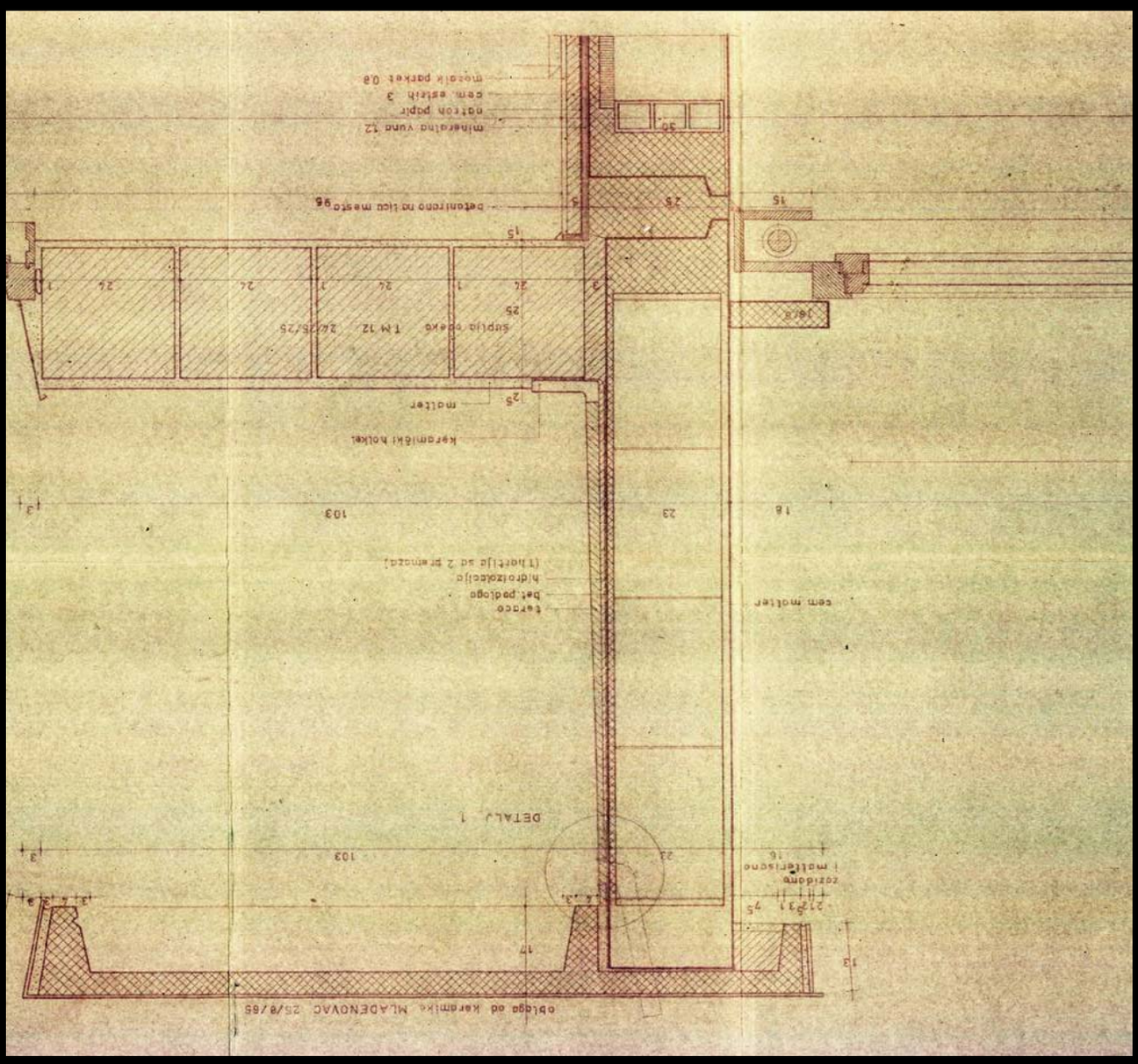


Figure: Balconies and façade (*source: Historical Archives of Belgrade*)